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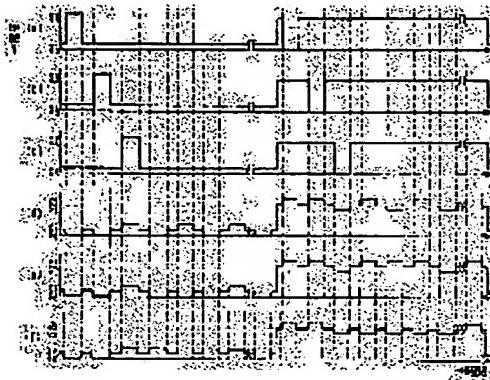
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(54) DRIVING METHOD FOR LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PURPOSE: To provide a driving method which can depress the occurrence of luminance irregularity in liquid crystal display devices irrespective of the display pattern.

CONSTITUTION: In the voltage impressed on the scanning electrodes, non-scanning voltage periods (quiescent period) are placed between the scanning pulses (a) and (b), and between the scanning pulses (b) and (c). And as seen in (d), (e), (f), the voltage impressed on the signal electrodes gives the drive waveforms which have quiescent periods where the potential is the same as the non-scanning voltage in the scanning electrode drive irrespective of displayed data. By this, the switching times (frequency component) of each signal voltage waveform are the same and luminance irregularity is mitigated.



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CLAIMS

[Claim(s)]

[Claim 1] Between the 1st substrate which prepared the signal-electrode group, and the 2nd substrate which prepared the scan electrode group which carried out the crossover array with said signal-electrode group Are the drive approach of the liquid crystal display of the matrix mold which pinched liquid crystal, and a non-scanning electrical-potential-difference period is prepared in said scan electrode group between the 1st scan pulse in the scan pulse which carries out sequential impression, and the 2nd following scan pulse. The drive approach of the liquid crystal display characterized by impressing said non-scanning electrical potential difference and this electrical potential difference to said signal-electrode group at this non-scanning electrical-potential-difference period.

[Claim 2] Between the 1st substrate which prepared the signal-electrode group, and the 2nd substrate which prepared the scan electrode group which carried out the crossover array with said signal-electrode group At the predetermined period over the 1st period which impresses the 1st scan pulse in the scan pulse which is the drive approach of the liquid crystal display of the matrix mold which pinched liquid crystal, and carries out sequential impression at said scan electrode group, and the 2nd period which impresses the 2nd next scan pulse of said 1st scan pulse The drive approach of the liquid crystal display characterized by impressing said non-scanning electrical potential difference and this electrical potential difference to said signal-electrode group.

[Claim 3] Between the 1st substrate which prepared the signal-electrode group, and the 2nd substrate which prepared the scan electrode group which carried out the crossover array with said signal-electrode group Are the drive approach of the liquid crystal display of the matrix mold which pinched liquid crystal, and a non-scanning electrical-potential-difference period is prepared in said scan electrode group between the 1st scan pulse in the scan pulse which carries out sequential impression, and the 2nd following scan pulse. The drive approach of the liquid crystal display characterized by impressing said non-scanning electrical potential difference and this electrical potential difference to said signal-electrode group at the predetermined period over this non-scanning electrical-potential-difference period.

[Claim 4] The drive approach of a liquid crystal display according to claim 1, 2, or 3 of performing electrical-potential-difference amendment in said scan electrode group based on the distortion electrical potential difference which prepared the detection electrode which a distortion electrical potential difference equivalent to the distortion electrical potential difference of the scan electrode by change of a signal level generates in the 2nd substrate which prepared the scan electrode group, and was generated in said detection electrode.

[Claim 5] The drive approach of a liquid crystal display according to claim 1, 2, or 3 of driving the liquid crystal display which set resistance per pixel of the electric supply and the direction of the last train on a scan electrode to 5ohms or less.

[Claim 6] The drive approach of the liquid crystal display according to claim 1, 2, or 3 characterized by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period in the middle of each scan period while displaying

halftone by pulse width modulation.

[Claim 7] The detection electrode which a distortion electrical potential difference equivalent to the distortion electrical potential difference of the scan electrode by change of a signal level generates is prepared in the 2nd substrate which prepared the scan electrode group. While performing electrical-potential-difference amendment in said scan electrode group based on the distortion electrical potential difference generated in said detection electrode and displaying halftone by pulse width modulation The drive approach of the liquid crystal display according to claim 1, 2, or 3 characterized by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period in the middle of each scan period.

[Claim 8] The drive approach of the liquid crystal display according to claim 1, 2, or 3 characterized by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period in the middle of each scan period while driving the liquid crystal display which set resistance per pixel of the electric supply and the direction of the last train on a scan electrode to 5ohms or less and displaying halftone by pulse width modulation.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the drive approach of the liquid crystal display of a matrix mold.

[0002]

[Description of the Prior Art] The electrical-potential-difference equalizing method which makes regularity effective voltage impressed to a non-selection period as the drive approach of the conventional matrix mold liquid crystal display is common (for example, JP,50-68419,A). For example, the case where the pattern of drawing 15 is displayed is explained. In drawing 15, as for a pixel, and 100, 110, 120 and 130, 140, 150, 160, 1, 2, and 3 are [a scan electrode and 200, 210, 220] signal electrodes, and the part in which the slash section in a part for the intersection of a scan electrode and a signal electrode (pixel) does not have a black display and a slash shows a white display among drawing. Drawing 16 shows the equal circuit of the part in connection with the scan electrode 100 of drawing 15. Moreover, drawing 17 is an applied-voltage wave form chart in the conventional electrical-potential-difference equalizing method, and the scan electrode applied-voltage wave form chart which impresses (a), (b), and (c) to the scan electrode 100, 110, 120 of drawing 15, respectively, this drawing (d), (e), and (f) are signal-electrode applied-voltage wave form charts impressed to a signal electrode 200, 210, 220, respectively.

[0003] Each potential difference in the crossing of a scan electrode and a signal electrode is impressed to each pixel. Signal-electrode applied voltage determines OFF [ON (ON)/] (OFF) of a pixel, and it takes ON/OFF actual value according to the difference of this and a scan electrode applied-voltage pulse.

[0004]

[Problem(s) to be Solved by the Invention] In this conventional electrical-potential-difference equalizing method, it becomes that from which the signal-electrode applied-voltage wave differed with the display pattern as shown in drawing 17 (d), (e), and (f). Moreover, the electrical potential difference actually impressed to each pixel will be intricately distorted by each of these different signal-electrode applied-voltage waves for the effect of the electrode resistance of a panel, or liquid crystal capacity. For this reason, different effective voltage from the effective voltage which should be impressed was added, and it had the trouble that will become display unevenness and image quality will deteriorate remarkably.

[0005] Next, the contents are explained. As shown in the equal circuit of drawing 16, as shown in drawing 18 (a), distortion produces the scan electrical potential difference in a node 101, 102, 103 with Resistance R and the pixel capacity C of the scan electrode 100 at the time of change of a signal level. Here, compared with resistance between nodes 99 and 101, the resistance between nodes 101 and 103 is small, and the potential of 101, 102, 103 is almost equal. Moreover, as shown in drawing 18 (b), (c), and (d), a wave-like distortion produces a node 201, 211, 221 with Resistance r and the pixel capacity C of a signal electrode. For this reason, the electrical potential difference impressed to the pixels 1, 2, and 3 of drawing 15 R> 5 becomes like drawing 18 (e), (f), and (g), takes the actual value from which what must take the same ON actual value differed in practice, and causes brightness unevenness. This phenomenon

becomes more remarkable by RF-izing of the drive frequency accompanying the increment in display capacity, the increment in electrical-potential-difference resistance, etc.

[0006] If the deformation amount of the scan electrical potential difference by change of one signal level and the deformation amount of a signal level are now assumed to be one unit, respectively in order to calculate these deformation amounts The pixel electrical-potential-difference (scan side applied-voltage-signal side applied voltage) deformation amount in the 2 fields in the non-selection period ta when the deformation amount changes with each indicative datas It is set to -28, -20, and -8, respectively (deformation amount difference 20 [a maximum of]), and the effective voltage impressed to the pixels 1, 2, and 3 which should be the brightness same originally will differ, and brightness unevenness will produce it.

[0007] Moreover, in order to remove the deformation amount of the above-mentioned scan electrical potential difference, the distorted electrical potential difference of a scan electrode is detected, and there is the approach of feeding back correction voltage to a scan electrical potential difference based on this detected scan electrical-potential-difference deformation amount (for example, an application for patent No. 74607 [62 to] and the "new driving method for cross talk display unevenness reduction of passive-matrix LCD", 1992 or 41 pages of Institute of Electronics, Information and Communication Engineers Shingaku Giho). However, although the brightness unevenness resulting from distortion of a scan electrical potential difference is removable by this approach, the brightness unevenness which each signal-level wave changes and originates in a count difference (frequency component difference) is completely unremovable. In order for a signal-level wave to change and to equalize a count difference next again, there is a method of reversing the polarity of all drives by the integral multiple of one scan period (period which has chosen the 1 scanning line) (for example, JP,60-19195,A). However, by this approach, when the scanning-line flicker arose with the set-up polarity-reversals period and it was made the polarity-reversals period which avoids these, the signal-level wave changed, a count difference did not become homogeneity depending on the display pattern, and a result which brightness unevenness produces too was brought.

[0008] Moreover, the case where a halftone display as shown in drawing 19 is performed is considered. In drawing 19 , the same sign is given to drawing 15 and a corresponding part, and the part in which a black display and the slash section of a dotted line do not have a halftone display and a slash as for the slash section of the continuous line in a part for the intersection of a scan electrode and a signal electrode (pixel) shows a white display among drawing. In order that drawing 20 may display the pattern shown in drawing 19 , it is an applied-voltage wave form chart, and the scan electrode applied-voltage wave form chart which impresses (a), (b), and (c) to the scan electrode 100,110,120, respectively, this drawing (d), (e), and (f) are signal-electrode applied-voltage wave form charts impressed to a signal electrode 200,210,220, respectively. The voltage waveform to which the voltage waveform by the side of the signal electrode of pixels 1, 2, and 3 is impressed for the voltage waveform by the side of the scan electrode of the pixels 1, 2, and 3 in this case by drawing 21 (a) at pixels 1, 2, and 3 at drawing 21 (b), (c), and (d) is shown in drawing 21 (e), (f), and (g).

[0009] In the pulse width modulation which displays halftone by switching ON and off-data according to gradation level within 1 scan period as shown in drawing 20 , the time of not changing to the time of a signal wave form changing within 1 scan period with gradation data arose, as shown in drawing 21 like the above from the difference in the frequency component by this, the electrical-potential-difference deformation amount in each pixel changed with gradation patterns, and brightness unevenness had arisen.

[0010] The purpose of this invention is solving the above-mentioned trouble and offering the drive approach of the liquid crystal display which can control generating of brightness unevenness regardless of a display pattern.

[0011]

[Means for Solving the Problem] The drive approach of a liquid crystal display according to claim 1 establishes a non-scanning electrical-potential-difference period at a scan electrode group between the 1st scan pulse in the scan pulse which carries out sequential impression, and the 2nd following scan

pulse, and is characterized by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at this non-scanning electrical-potential-difference period.

[0012] The drive approach of a liquid crystal display according to claim 2 is characterized by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period over the 1st period which impresses the 1st scan pulse in the scan pulse which carries out sequential impression to a scan electrode group, and the 2nd period which impresses the 2nd next scan pulse of the 1st scan pulse. The drive approach of a liquid crystal display according to claim 3 establishes a non-scanning electrical-potential-difference period at a scan electrode group between the 1st scan pulse in the scan pulse which carries out sequential impression, and the 2nd following scan pulse, and is characterized by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period over this non-scanning electrical-potential-difference period.

[0013] In the drive approach of a liquid crystal display according to claim 1, 2, or 3, the drive approach of a liquid crystal display according to claim 4 prepares the detection electrode which a distortion electrical potential difference equivalent to the distortion electrical potential difference of the scan electrode by change of a signal level generates in the 2nd substrate which prepared the scan electrode group, and performs electrical-potential-difference amendment in a scan electrode group based on the distortion electrical potential difference generated in the detection electrode. The drive approach of a liquid crystal display according to claim 5 drives the liquid crystal display which set resistance per pixel of the electric supply and the direction of the last train on a scan electrode to 5ohms or less in the drive approach of a liquid crystal display according to claim 1, 2, or 3.

[0014] In the drive approach of a liquid crystal display according to claim 1, 2, or 3, the drive approach of a liquid crystal display according to claim 6 is characterized by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period in the middle of each scan period while it displays halftone by pulse width modulation. The drive approach of a liquid crystal display according to claim 7 is set to the drive approach of a liquid crystal display according to claim 1, 2, or 3. The detection electrode which a distortion electrical potential difference equivalent to the distortion electrical potential difference of the scan electrode by change of a signal level generates is prepared in the 2nd substrate which prepared the scan electrode group. While performing electrical-potential-difference amendment in a scan electrode group based on the distortion electrical potential difference generated in the detection electrode and displaying halftone by pulse width modulation, it is characterized by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period in the middle of each scan period.

[0015] In the drive approach of a liquid crystal display according to claim 1, 2, or 3, the drive approach of a liquid crystal display according to claim 8 is characterized by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period in the middle of each scan period while it drives the liquid crystal display which set resistance per pixel of the electric supply and the direction of the last train on a scan electrode to 5ohms or less and displays halftone by pulse width modulation.

[0016]

[Function] Two causes exist in the brightness unevenness produced by the harmonic voltage distortion at the time of driving a liquid crystal display. One is an electrical-potential-difference strain difference by the display pattern of each signal-level wave change and according to a count difference (frequency component difference), and another is distortion of the scan electrical potential difference by change of a signal level.

[0017] By impressing the non-scanning electrical potential difference and this electrical potential difference which are impressed to a scan electrode group between the 1st scan pulse and the 2nd scan pulse or at the period over the 1st scan pulse and the 2nd scan pulse to a signal-electrode group according to the drive approach of this invention The electrical-potential-difference strain difference by

the signal level which changes and originates in a count difference (frequency component difference) can be fixed irrespective of a display pattern, and little high-definition display of brightness unevenness can be enabled also in the panel of large display capacity. By the approach of impressing especially the non-scanning electrical potential difference impressed to a scan electrode group between the 1st scan pulse and the 2nd scan pulse, and this electrical potential difference to a signal-electrode group, since an ON/OFF actual-value ratio can be taken on a par with the former, where the conventional contrast is held, the display without brightness unevenness can be enabled.

[0018] Furthermore, the thing for which electrical-potential-difference amendment is performed in a scan electrode group based on the distortion electrical potential difference which prepared the detection electrode which a distortion electrical potential difference equivalent to the distortion electrical potential difference of the scan electrode by change of a signal level generates, and was generated in this detection electrode, Or by setting resistance per pixel of the electric supply and the direction of the last train on a scan electrode to 5ohms or less The deformation amount of the electrical potential difference of the scan electrode by change of the electrical potential difference of a signal electrode can be mitigated sharply, and the more nearly high-definition display which the two synergistic effects show up, is not based on a display pattern, and does not have brightness unevenness can be enabled by improving the two above-mentioned causes to coincidence.

[0019] Furthermore, while displaying halftone by pulse width modulation, by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period in the middle of each scan period, with any halftone data, it can change, a count can be made the same and the high-definition display without brightness unevenness can be enabled irrespective of all the display patterns including a halftone display within 1 scan period of a signal level.

[0020]

[Example]

(The 1st example) The drive approach of the liquid crystal display of the 1st example this invention is explained hereafter, referring to a drawing. Drawing 1 and drawing 2 are the electrical-potential-difference wave form charts in the drive approach of the liquid crystal display of the 1st example this invention, the scan electrode applied-voltage wave form chart which impresses (a) of drawing 1, (b), and (c) to the scan electrode 100,110,120 in drawing 15, respectively, drawing 1 (d), (e), and (f) are the signal-electrode applied-voltage wave form charts impressed to a signal electrode 200,210,220, respectively, and each potential difference is impressed to each pixel. A signal-level wave [in / in a scan voltage waveform / in / in drawing 2 R> 2 (a) / the node 101,102,103 of drawing 16 /, drawing 2 (b), (c), and (d) / a node 201,211,221], drawing 2 (e), (f), and (g) show the voltage waveform impressed to the pixels 1, 2, and 3 of drawing 15.

[0021] In this example, the polarity of applied voltage is reversed for every scan period like the conventional example indicated to be drawing 17, and 18 and drawing 20 to 21. Namely, with the 1 first scan period, in drawing 1 (a), (b), and (c), by making V0 into reference voltage, V5 is made into a scan electrical potential difference, V1 is made into a non-scanning electrical potential difference, and V2 is made into the selection electrical potential difference by making V0 into reference voltage in drawing 1 (d), (e), and (f). With the 1 following scan period, in drawing 1 (a), (b), and (c), by making V5 into reference voltage, V0 is made into a scan electrical potential difference, V4 is made into a non-scanning electrical potential difference, and V3 is made into the selection electrical potential difference by making V5 into reference voltage in drawing 1 (d), (e), and (f). Therefore, with the 1 first scan period and the 1 following scan period, the polarity of all the electrical potential differences to reference voltage is reversed, and as shown in drawing 2 (e), (f), and (g), the electrical potential difference impressed to pixels 1, 2, and 3 serves as a perfect AC signal in 2 scan periods.

[0022] Furthermore, in this example, scan electrode applied voltage has established the period (idle period) of a non-scanning electrical potential difference (V1, V4) between the scan pulse of (b), and the scan pulse of (c) between the scan pulse of (a), and the scan pulse of (b), as shown in drawing 1 (a), (b), and (c). And signal-electrode applied voltage is a period between a scan pulse and a scan pulse, and he is

trying to impress a drive wave with an idle period which once becomes the non-scanning electrical potential difference and same electric potential in a scan electrode drive irrespective of an indicative data, as shown in drawing 1 (d), (e), and (f). Thereby, each signal-level wave changes, a count (frequency component) becomes equal, respectively and brightness unevenness is eased.

[0023] By the drive approach of this example, the signal level in distortion and a node 201,211,221 is set to drawing 2 (b), (c), and (d) like drawing 2 (a) in the scan electrical potential difference in the node 101,102,103 of drawing 16. Therefore, the electrical potential difference impressed to pixels 1, 2, and 3 is distorted like drawing 2 (e), (f), and (g). If the deformation amount of the scan electrical potential difference by one change of a signal level and the deformation amount of a signal level are made into one unit like the conventional example here, since the electrical-potential-difference deformation amount in the 2 fields in the non-selection period ta when the deformation amount changes with each indicative data will be set to -11.2, -9.6, and -8, respectively and the deformation amount difference in each pixel will become small compared with the conventional example (the maximum difference 3.1), brightness unevenness is also improved greatly.

[0024] Moreover, as the electrical potential difference on which the drive approach of this example is impressed to pixels 1, 2, and 3 to the conventional drive approach is shown in drawing 2 (e), (f), and (g), it is that zero potential is only contained at the idle period. Therefore, an ON/OFF electrical-potential-difference actual-value ratio can maintain most actual-value ratios in the conventional drive approach, is in the condition holding the conventional contrast, and can reduce brightness unevenness.

[0025] Thus, by the drive approach of this example, the electrical-potential-difference strain difference by the display pattern of each signal-level wave which changes and originates in a count difference (frequency component difference) can be set constant irrespective of a display pattern, and little high-definition display of brightness unevenness can be enabled also in the panel of large display capacity. In addition, since a signal wave form changes about an idle period even in an idle period even existing for a while and a count becomes uniform in every signal pattern, the effectiveness of this invention begins to show up and can improve brightness unevenness. Moreover, about an idle period, effectiveness changes with how to become blunt at the time of the drive wave change rate by the time constant decided by the resistance which each signal line of a liquid crystal display has, and capacity. When signal-electrode side potential impressed to the pixel in the steady state which made 0% signal-electrode side potential impressed to the pixel at the time of a drive wave change rate, and carried out the passage of time enough after the wave change rate is now made into 100%, When the period of the time of the signal-electrode side potential impressed to a pixel changing to 50% was made into the idle period after the wave change rate and having been evaluated by the actual panel, the effectiveness was accepted enough. And after the wave change rate, by making into an idle period the period of the time of the signal-electrode side potential impressed to a pixel becoming 100% or more, even if the effect affect the pixel electrical potential difference by the side of a signal electrode performed the drive corresponding to what kind of display pattern, it became equal and brightness unevenness was hardly observed.

Therefore, in a setup of an idle period, although the effectiveness of this invention begins to show up by setting up an idle period, by setting up the 50 above-mentioned% or more of period, effectiveness becomes good and the effectiveness becomes good especially by setting up the 100 above-mentioned% or more of period.

[0026] Moreover, although liquid crystal display mode can demonstrate that effectiveness greatly especially in STN (Super-Twisted-Nematic) mode with a steep threshold property in this example To the 1st [this] example [5th] below of an example, if the drive approach of this invention is the liquid crystal display panel which pinched liquid crystal between the substrates of the pair which has a scan electrode group and a signal-electrode group in an opposed face irrespective of the display mode of liquid crystal By using the drive approach of this invention also with the liquid crystal display using the other modes, the brightness unevenness by pixel driver voltage distortion as well as an example is improvable. TN (Twisted-Nematic) mode, electric field effect birefringence mode, etc. are mentioned concerning this.

[0027] (The 2nd example) The drive approach of the liquid crystal display of the 2nd example this

invention is explained hereafter, referring to a drawing. The scan electrode applied-voltage wave form chart and signal-electrode applied-voltage wave form chart in this example are the same as that of the 1st example shown in drawing 1. However, in this example, the circuit for removing distortion of the scan electrical potential difference by change of a signal level is added to the scan electrode in a liquid crystal display. The circuitry of the liquid crystal display in this example is shown in drawing 3. drawing 3 -- setting -- 10 -- a liquid crystal panel and 11 -- a scan electrode and 12 -- a signal electrode and 13 -- for a detection electrode and 16, as for a correction voltage generating circuit and 18, a detector and 17 are [a scan driver and 14 / a signal driver and 15 / a control circuit and 19] driver voltage generating circuits. Drawing 5 is an electrical-potential-difference wave form chart in this 2nd example, and a signal-level wave [in / in a scan voltage waveform / in / in drawing 5 (a) / the node 101,102,103 of drawing 16 /, drawing 5 (b), (c), and (d) / a node 201,211,221], drawing 5 (e), (f), and (g) show the voltage waveform impressed to the pixels 1, 2, and 3 of drawing 15 like drawing 2.

[0028] In the liquid crystal display of a matrix mold, a distortion electrical potential difference generates the signal-electrode applied voltage supplied by the signal driver 14 on the scan electrode 11 in the time of a signal-level change rate for coupling by liquid crystal. In this example, a distortion electrical potential difference occurs in the detection electrode 15 as well as the scan electrode 11 by adding the scan electrode 11 and the same detection electrode 15 to the substrate by the side of a scan electrode. The harmonic voltage distortion generated on the scan electrode 11 can be stopped by using the method of applying the distortion electrical potential difference generated in this detection electrode 15 to driver voltage Rhine of the scan driver 13 or even if it lets the correction voltage generating circuit 17 which detects by the detector 16 which consisted of input terminals of an operational amplifier etc., amplifies this detection electrical potential difference, and is made into an opposite phase pass.

[0029] In addition, this method detects the harmonic voltage distortion which signal-electrode applied voltage changes and is sometimes generated on the scan electrode 11, it is an example which amends an electrical potential difference to the scan electrode 11 based on it, and as long as it is a method which can amend the harmonic voltage distortion generated on the scan electrode 11, what kind of method may be used for it. By this method, the deformation amount of the scan electrode by change of a signal level is mitigated compared with the 1st example of drawing 2 (a) like drawing 5 (a), and the deformation amount of the scan electrical potential difference of 1 time of a signal level depended for changing is reduced from one unit of the 1st example to 0.1 unit extent. If it calculates like the conventional example, the electrical potential differences impressed to pixels 1, 2, and 3 will be drawing 5 (e), (f), and (g), the electrical-potential-difference deformation amount of the 2nd example in the 2 fields in each ***** ta is set to -4.7, -4.6, and -4.4, respectively, the differences of a deformation amount will be few or the difference of them will almost be lost with 0.3.

[0030] moreover -- on the other hand, the method of only removing distortion of the scan electrical potential difference by change of a signal level by the conventional drive approach -- using -- asking -- coming out -- the electrical-potential-difference deformation amounts in the 2 fields in the non-selection period ta of the electrical potential difference impressed to pixels 1, 2, and 3 are -11.8, -7.4, and -2.6, respectively, the difference of a deformation amount is set to 9.2 and, now, brightness unevenness seldom improves. It is because a signal-electrode driver voltage wave changes only by this cause removing distortion of a scan electrical potential difference and the difference of the deformation amount by the count difference (frequency component difference) does not improve. However, by using together the drive approach of the 1st example, and the method of removing the distorted electrical potential difference on a scan electrode like this 2nd example, the synergistic effect of two approaches can show up, the both sides of the cause of brightness unevenness which stated in an operation can be improved to coincidence, and brightness unevenness is improved greatly.

[0031] In addition, in drawing 3, although the detection electrode 15 is formed in the electric supply side of a signal electrode 12, even if it prepares in a last train side, the same effectiveness as the above can be acquired. Moreover, if the detection electrode 15 is formed in both by the side of electric supply of a signal electrode 12, and the last train and it asks for correction voltage by detection from these two detection electrodes 15 as shown in drawing 4 since the distorted electrical potential difference which

rides on a scan electrode has a difference by the electric supply [which was seen from the signal-electrode side], and last train side, a distorted electrical potential difference can be removed with a still more sufficient precision. Moreover, if distortion of the scan electrical potential difference not only by a thing but signal-level change shown in this 2nd example about the amendment approach is removed, like the 2nd example, the synergistic effect with the drive approach in the 1st example can show up, the both sides of the cause of brightness unevenness which stated in an operation can be improved to coincidence, and brightness unevenness can be improved greatly.

[0032] In addition, some scan electrodes 11 may be used for the detection electrode 15 in drawing 3 and drawing 4 as a substitute of a detection electrode.

(The 3rd example) The drive approach of the liquid crystal display of the 3rd example this invention is explained hereafter, referring to a drawing.

[0033] In the 1st example, the sheet resistance of a scan electrode is 10ohm/**, and this example is lowered until resistance per pixel is set to 1 ohm with auxiliary wiring of metals, such as aluminum which installed that whose resistance per pixel of a direction which goes to a last train side from the electric supply side on a scan electrode was 10ohms in the scan electrode side by side. The scan electrode applied-voltage wave form chart and the signal-electrode applied-voltage wave form chart are the same as that of the 1st example shown in drawing 1. Drawing 6 is an electrical-potential-difference wave form chart in this 3rd example, and a signal-level wave [in / in a scan voltage waveform / in / in drawing 6 (a) / the node 101,102,103 of drawing 16 /, drawing 6 (b), (c), and (d) / a node 201,211,221], drawing 6 (e), (f), and (g) show the voltage waveform impressed to the pixels 1, 2, and 3 of drawing 15 like drawing 2 R> 2.

[0034] As the deformation amount of the scan electrical potential difference by change of a signal level is shown in drawing 6 (a), compared with the 1st example shown by drawing 2 (a), it is sharply mitigated by scan electrode low resistance-ization of this example, and the deformation amount of the scan electrical potential difference of 1 time of a signal level depended for changing is reduced from one unit of the conventional example to 0.3 unit extent by it. When it calculates similarly, the electrical potential differences impressed to pixels 1, 2, and 3 are drawing 6 (e), (f), and (g), the electrical-potential-difference deformation amount in the 2 fields in the non-selection period ta is set to -6.4, -5.9, and -5.3, respectively, and a deformation amount is small compared with the former, and a difference is also quite small (the maximum difference 1.1).

[0035] To this, the electrical-potential-difference deformation amounts in the 2 fields in the non-selection period ta of the electrical potential difference impressed to pixels 1, 2, and 3 only by setting resistance per pixel to 1 ohm only using an auxiliary electrode by the conventional drive approach are -16, -10.6, and -4, respectively, the difference of a deformation amount is set to 12 and, now, brightness unevenness produces it again. This cause is also because a signal-electrode driver voltage wave changes and the difference of the deformation amount by the count difference (frequency component difference) is not improved like the 2nd example. Therefore, even if it only forms scan electrode resistance into low resistance, the wave-like frequency component by the side of a signal electrode does not change, but brightness unevenness seldom improves. However, like this 3rd example, by using together the drive approach of the 1st example, and scan electrode low resistance-ization, the synergistic effect of two approaches shows up and brightness unevenness can be improved greatly. It stops moreover, almost producing brightness unevenness, as the resistance per pixel of the electric supply and the direction of the last train on a scan electrode was 5ohms or less, effectiveness showed up [as opposed to / especially / the 1st example], and it showed above, when this scan electrode low resistance-ization was 1ohm or less further.

[0036] In addition, although the approach of low ***** [electrode / scan] of having used metal auxiliary wiring was used in this example, if it is the approach of reduction in scan electrode resistance, such as not only this approach but mere reduction in ITO electrode resistance, the difference of the driver voltage wave deformation amount impressed to each pixel as well as this example can be reduced, and brightness unevenness can be improved greatly.

(The 4th example) The drive approach of the liquid crystal display of the 4th example this invention is

explained hereafter, referring to a drawing.

[0037] Drawing 7 is an applied-voltage wave form chart in the drive approach of the liquid crystal display of the 4th example this invention, and the scan electrode applied-voltage wave and drawing 7 (d) which impress drawing 7 (a), (b), and (c) to the scan electrode 100,110,120 in drawing 15, respectively, (e), and (f) show the signal-electrode applied-voltage wave impressed to a signal electrode 200,210,220, respectively. Drawing 8 is an electrical-potential-difference wave form chart in this 4th example, and a signal-level wave [in / in a scan voltage waveform / in / in drawing 8 (a) / the node 101,102,103 of drawing 16 /, drawing 8 (b), (c), and (d) / a node 201,211,221], drawing 8 (e), (f), and (g) show the voltage waveform impressed to the pixels 1, 2, and 3 of drawing 15 like drawing 2.

[0038] In this 4th example, although signal-electrode drive / scan electrode drive had prepared the idle period of a driver voltage wave between the scan pulse and the scan pulse in the 1st - the 3rd example, as shown in drawing 7, an idle period is set only to a signal-electrode drive, and this serves as a form over two scan periods. Although the principle which drives a signal electrode of changing, and not depending for a count difference on a pattern, but fixing is completely the same as the 1st example, in this example, it has the description which can make low pressure-proofing of IC which drives a liquid crystal panel compared with the drive approach of the 1st example.

[0039] By the approach of the 1st example, since the idle period is contained compared with the conventional pixel voltage waveform (drawing 18 (e), (f), (g)) as a pixel voltage waveform is shown in drawing 2 (e), (f), and (g), the electrical-potential-difference actual value impressed to a pixel will fall. For this reason, since liquid crystal is driven, it must stop having to set up a pulse voltage more highly than before, and pressure-proofing of IC for a drive must also be made high. However, since it becomes the form where the middle electrical potential difference of an on-pulse and an off-pulse joined the both-ends period of a selection pulse as this example shows to drawing 8 (e), (f), and (g), an actual-value fall can be suppressed and pressure-proofing of Drive IC can also be suppressed low.

[0040] By this drive approach, since the ON/OFF actual-value ratio of an electrical potential difference which drives a pixel will become low to the conventional example and the 1st example, as shown in drawing 9, the optimal drive approach according to drive IC pressure-proofing can be acquired by making it shorter than what showed the idle period of a scan electrical potential difference to the 1st example, and setting up the idle period of a signal level ranging over two scan periods. In addition, the scan electrode applied-voltage wave and drawing 9 (d) which impress drawing 9 (a), (b), and (c) to the scan electrode 100,110,120 in drawing 15, respectively, (e), and (f) show the signal-electrode applied-voltage wave impressed to a signal electrode 200,210,220, respectively.

[0041] Moreover, also in the drive approach of this example, brightness unevenness is greatly improvable like the 2nd and 3rd example by combining the approach of removing distortion of the scan electrical potential difference by signal-level change.

(The 5th example) The drive approach of the liquid crystal display of the 5th example this invention is explained hereafter, referring to a drawing.

[0042] Drawing 10 shows the electrode applied-voltage wave in this example when pulse width modulation performs the halftone display shown in drawing 18. It comes out, and it is and the scan electrode applied-voltage wave and drawing 10 $R > 0$ (d) which impress drawing 10 (a), (b), and (c) to the scan electrode 100,110,120 in drawing 19, respectively, (e), and (f) show the signal-electrode applied-voltage wave impressed to a signal electrode 200,210,220, respectively. Drawing 11 is an electrical-potential-difference wave form chart in this 4th example, and a signal-level wave [in / in a scan voltage waveform / in / in drawing 11 (a) / the node 101,102,103 of drawing 16 /, drawing 11 (b), (c), and (d) / a node 201,211,221], drawing 11 (e), (f), and (g) show the voltage waveform impressed to the pixels 1, 2, and 3 of drawing 19 like drawing 2.

[0043] Like this example, in the case of the halftone display pattern, as shown in drawing 10, the idle period which becomes a non-scanning electrical potential difference and same electric potential is prepared in scan electrode applied voltage and signal-electrode applied voltage into each scan period. Thereby, a pixel electrical potential difference becomes like drawing 11 (e), (f), and (g). In the above-mentioned example, by using this approach, the difference of the deformation amount by the count

difference of reversal of a signal-electrode driver voltage wave (frequency component difference) becomes the same small to every halftone data.

[0044] Moreover, the same is said of the ability to make brightness unevenness improve greatly by using together the approach that distortion of the scan electrical potential difference by change of a signal level is removed, like the 2nd and 3rd example. In the halftone display in the pulse width modulation in the former, since the case where it did not change to the case where a signal wave form changes within 1 scan period, with halftone data arose and the counts of the waveform distortion by the count of a signal change rate differed by this, brightness unevenness had arisen according to the same mechanism as the case where the display pattern in a binary display changes. However, according to this example, irrespective of all halftone data, it can change, a count can be made the same and this uniform liquid crystal display without brightness unevenness can be obtained.

[0045] Moreover, although the ON/OFF actual-value ratio of an electrical potential difference which drives a pixel like the 1st example also about this approach is a method to maintain, the electrical-potential-difference actual value concerning a pixel must become a small thing to the former, and must make high pressure-proofing of the drive IC of a liquid crystal panel. For this reason, the idle period of the scan electrical-potential-difference pulse of the place shown in drawing 10 (a), (b), and (c) is lost, and if a drive wave as shown in drawing 12 (a), (b), and (c) is used, a pixel applied-voltage wave can become like drawing 13 (e), (f), and (g), can suppress the fall of actual value, and can suppress pressure-proofing of Drive IC. in addition, drawing 12 R> 2 (a) - (f) -- (a) - (f) of drawing 10 -- the same -- the wave of scan electrode applied voltage and signal-electrode applied voltage -- being shown -- drawing 13 (a) - (g) -- (a) - (g) of drawing 11 -- the voltage waveform impressed to the pixels 1, 2, and 3 of a scan voltage waveform, a signal-level wave, and drawing 19 is shown similarly.

[0046] Moreover, the ON/OFF electrical-potential-difference actual-value ratio of a pixel will become small from before also about the approach shown in drawing 12 and drawing 13. Here, the optimal drive approach according to pressure-proofing of the liquid crystal drive IC can be acquired by using the drive approach used as drawing 10 and the middle of drawing 12 R> 2 as shown in drawing 14, i.e., the method of impressing the middle electrical potential difference of a scan electrical potential difference and a non-scanning electrical potential difference for the scan electrode applied voltage in an idle period. in addition, drawing 14 (a) - (f) -- (a) - (f) of drawing 10 -- the wave of scan electrode applied voltage and signal-electrode applied voltage is shown similarly.

[0047] Moreover, although the difference of the electrical-potential-difference deformation amount by halftone data is removable only by the drive approach shown in this example, it generates like before and brightness unevenness produces the electrical-potential-difference distortion of a display pattern depended for changing. Therefore, since this is improved, the high-definition display without brightness unevenness can be enabled irrespective of all display patterns including a halftone display by combining the drive approach of the 1st - the 4th example, and the drive approach of this 5th example.

[0048] In addition, if this invention is the drive approach that set the amount of distortion of a signal level constant irrespective of a display pattern, and the amount of distortion of signal-electrode applied voltage changes with display patterns, namely, that from which a signal-electrode applied-voltage wave changes with a display pattern, and the thing not changing exist, it can improve brightness unevenness by applying the drive approach of this invention. Moreover, although the drive approach that the electrical potential difference which is made to reverse the polarity of the scan electrode applied voltage to reference voltage (V0, V5) and signal-electrode applied voltage, and is impressed to a pixel served as a perfect AC signal in 2 scan periods was used for every scan period in the above-mentioned example, no matter this polarity-reversals period may be what period, brightness unevenness is improvable by using the drive approach of this invention.

[0049]

[Effect of the Invention] As mentioned above the drive approach of the liquid crystal display this invention By impressing the non-scanning electrical potential difference and this electrical potential difference which are impressed to a scan electrode group between the 1st scan pulse and the 2nd scan pulse or at the period over the 1st scan pulse and the 2nd scan pulse to a signal-electrode group The

electrical-potential-difference strain difference by the signal level which changes and originates in a count difference (frequency component difference) can be fixed irrespective of a display pattern, and little high-definition display of brightness unevenness can be enabled also in the panel of large display capacity. By the approach of impressing especially the non-scanning electrical potential difference impressed to a scan electrode group between the 1st scan pulse and the 2nd scan pulse, and this electrical potential difference to a signal-electrode group, since an ON/OFF actual-value ratio can be taken on a par with the former, where the conventional contrast is held, the display without brightness unevenness can be enabled. Furthermore, the thing for which electrical-potential-difference amendment is performed in a scan electrode group based on the distortion electrical potential difference which prepared the detection electrode which a distortion electrical potential difference equivalent to the distortion electrical potential difference of the scan electrode by change of a signal level generates, and was generated in this detection electrode, Or by setting resistance per pixel of the electric supply and the direction of the last train on a scan electrode to 5ohms or less, the deformation amount of the electrical potential difference of the scan electrode by change of the electrical potential difference of a signal electrode can be mitigated sharply, and the more nearly high-definition display which is not based on a display pattern and does not have brightness unevenness can be enabled.

[0050] Furthermore, while displaying halftone by pulse width modulation, by impressing a non-scanning electrical potential difference and this electrical potential difference to a signal-electrode group at the predetermined period in the middle of each scan period, with any halftone data, it can change, a count can be made the same and the high-definition display without brightness unevenness can be enabled irrespective of all the display patterns including a halftone display within 1 scan period of a signal level.

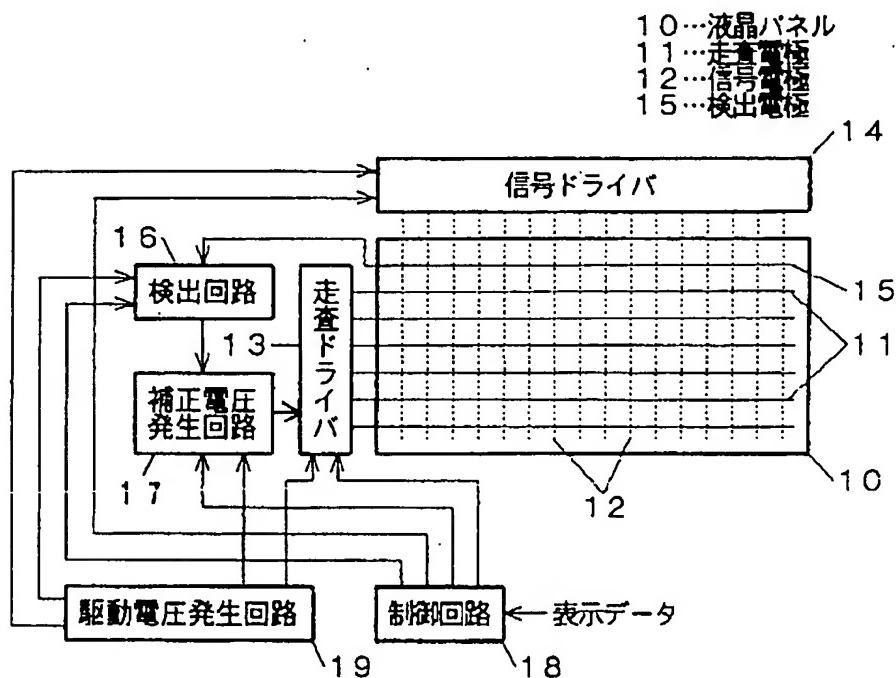
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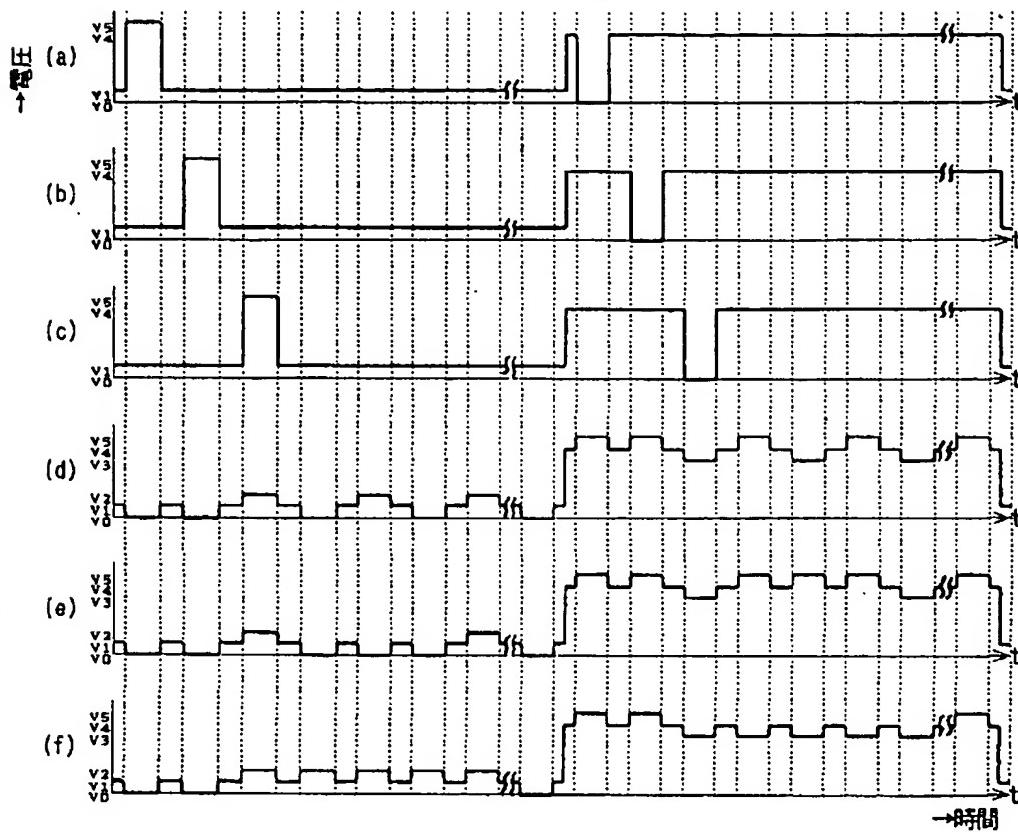
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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

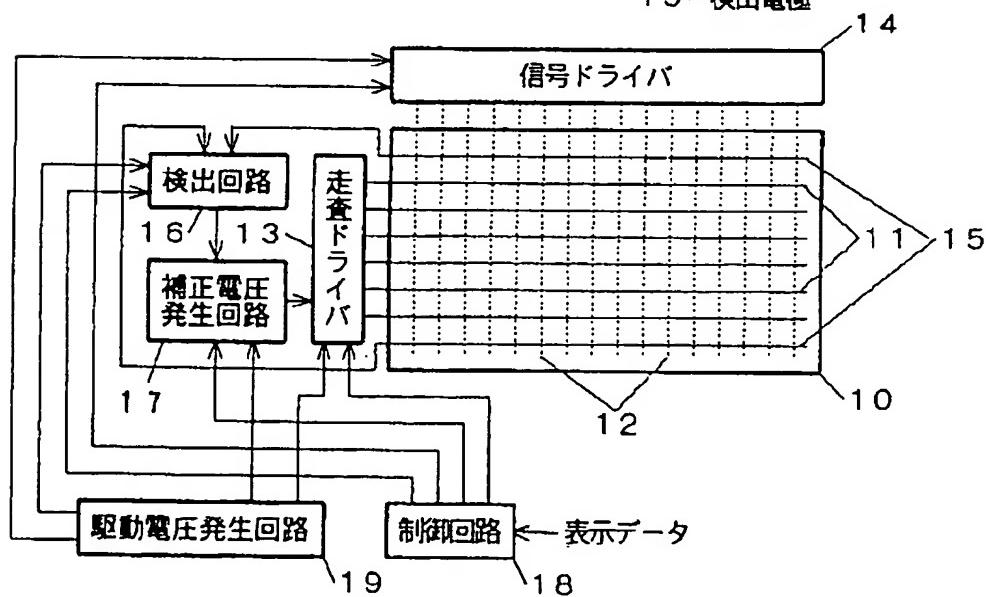
DRAWINGS

[Drawing 3]**[Drawing 1]**

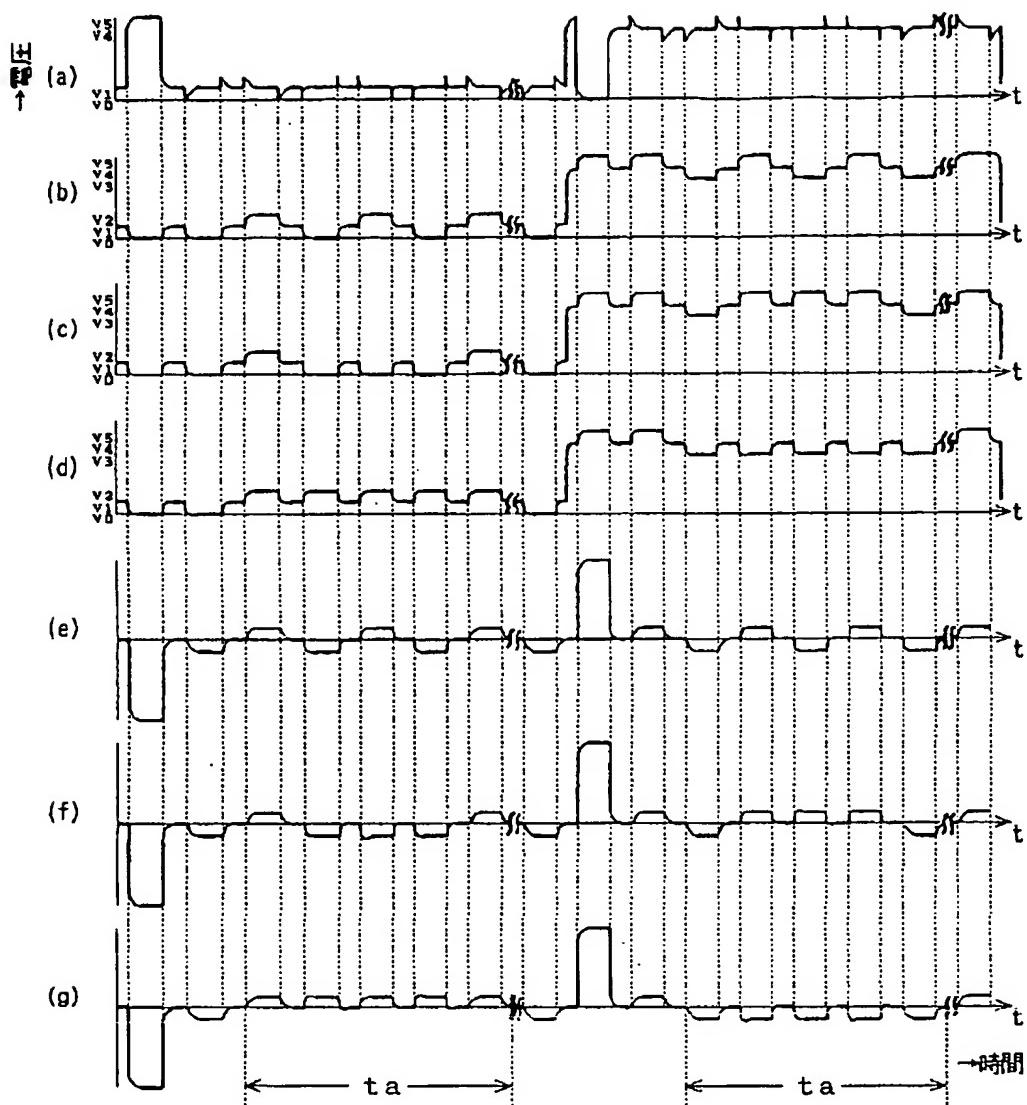


[Drawing 4]

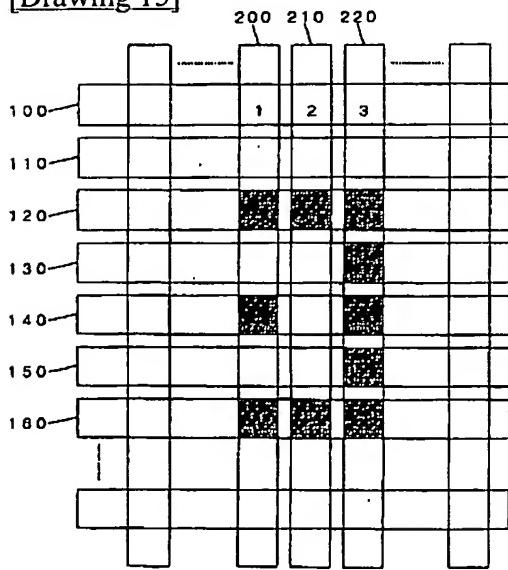
10…液晶パネル
11…走査電極
12…信号電極
15…検出電極



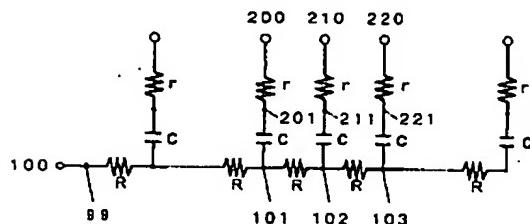
[Drawing 2]



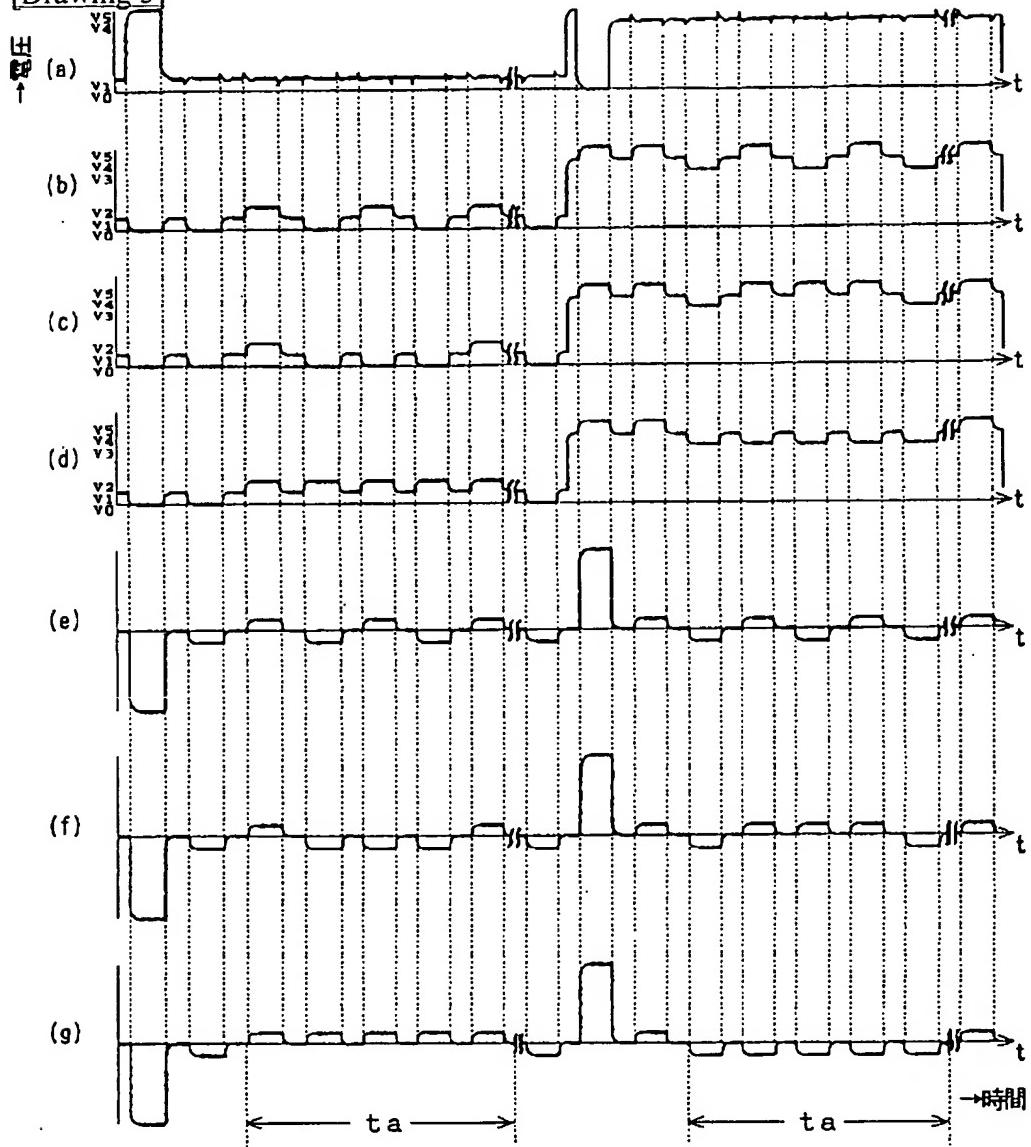
[Drawing 15]



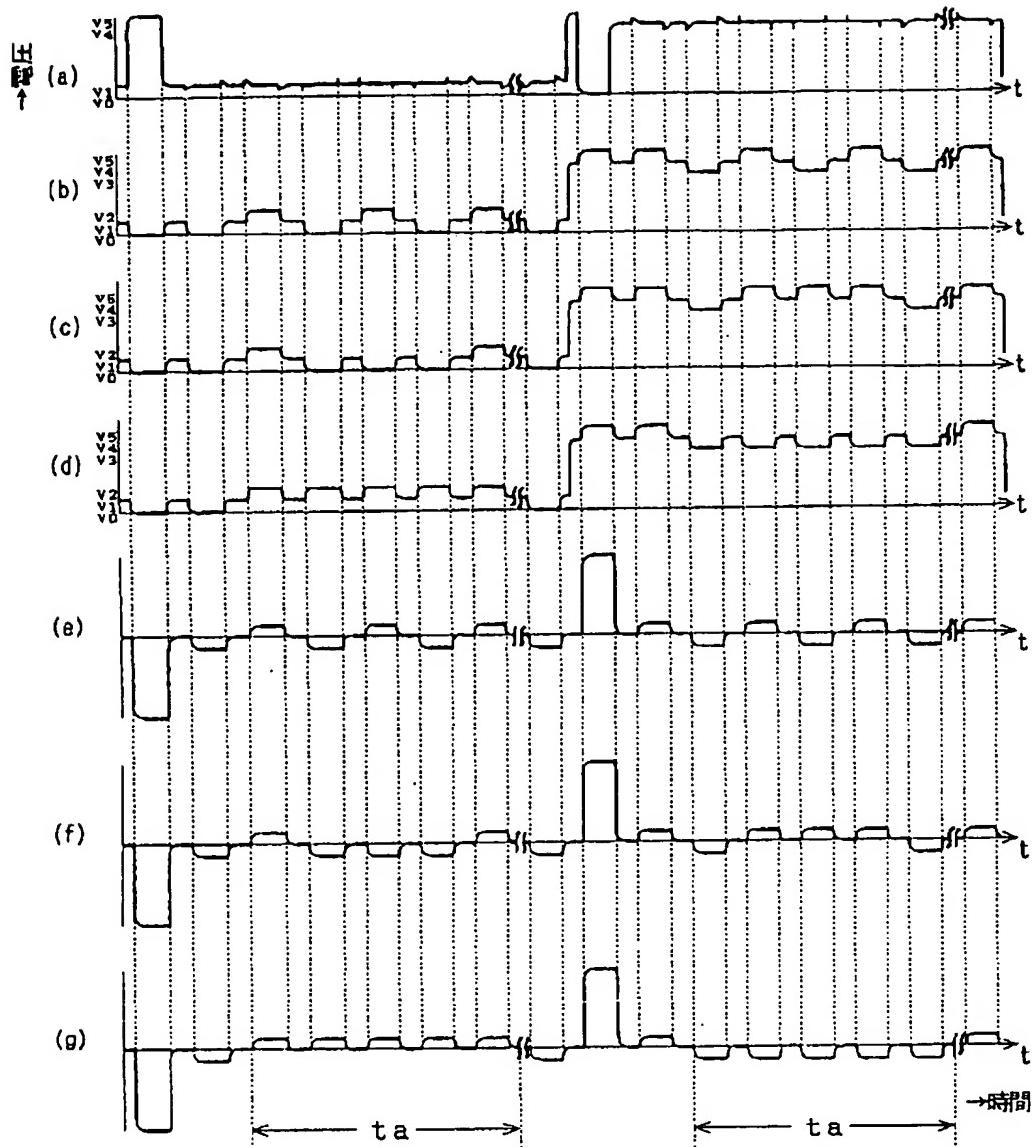
[Drawing 16]



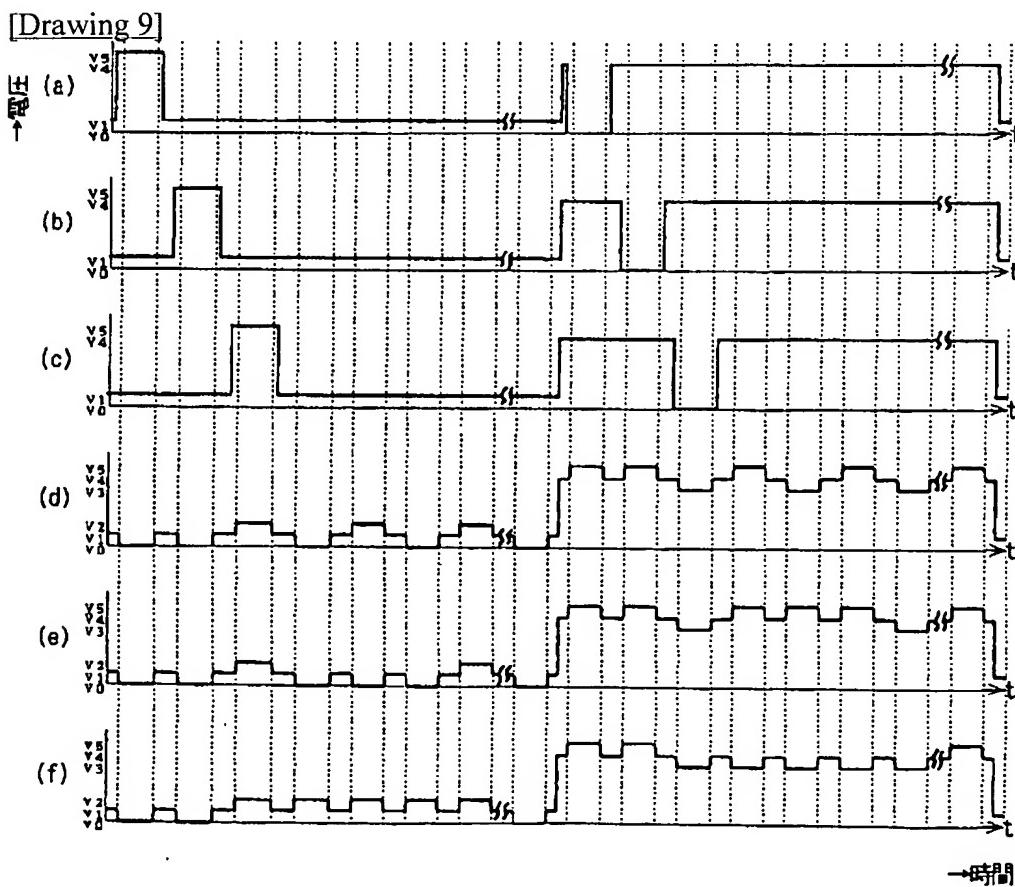
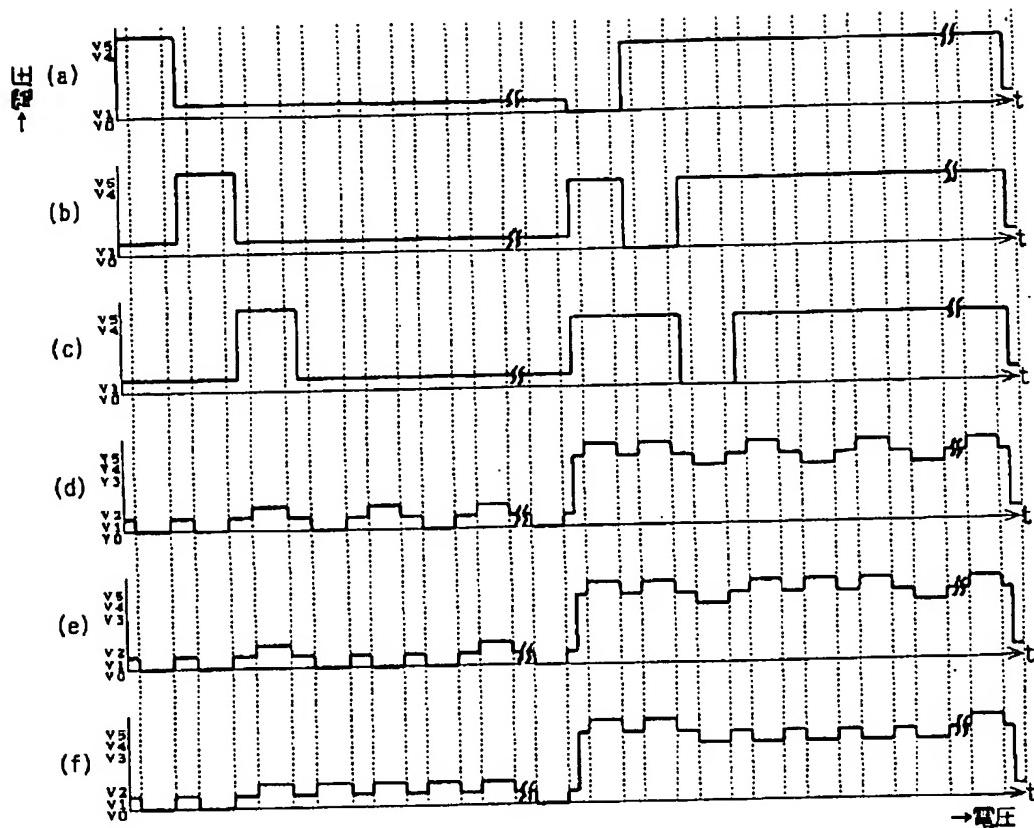
[Drawing 5]



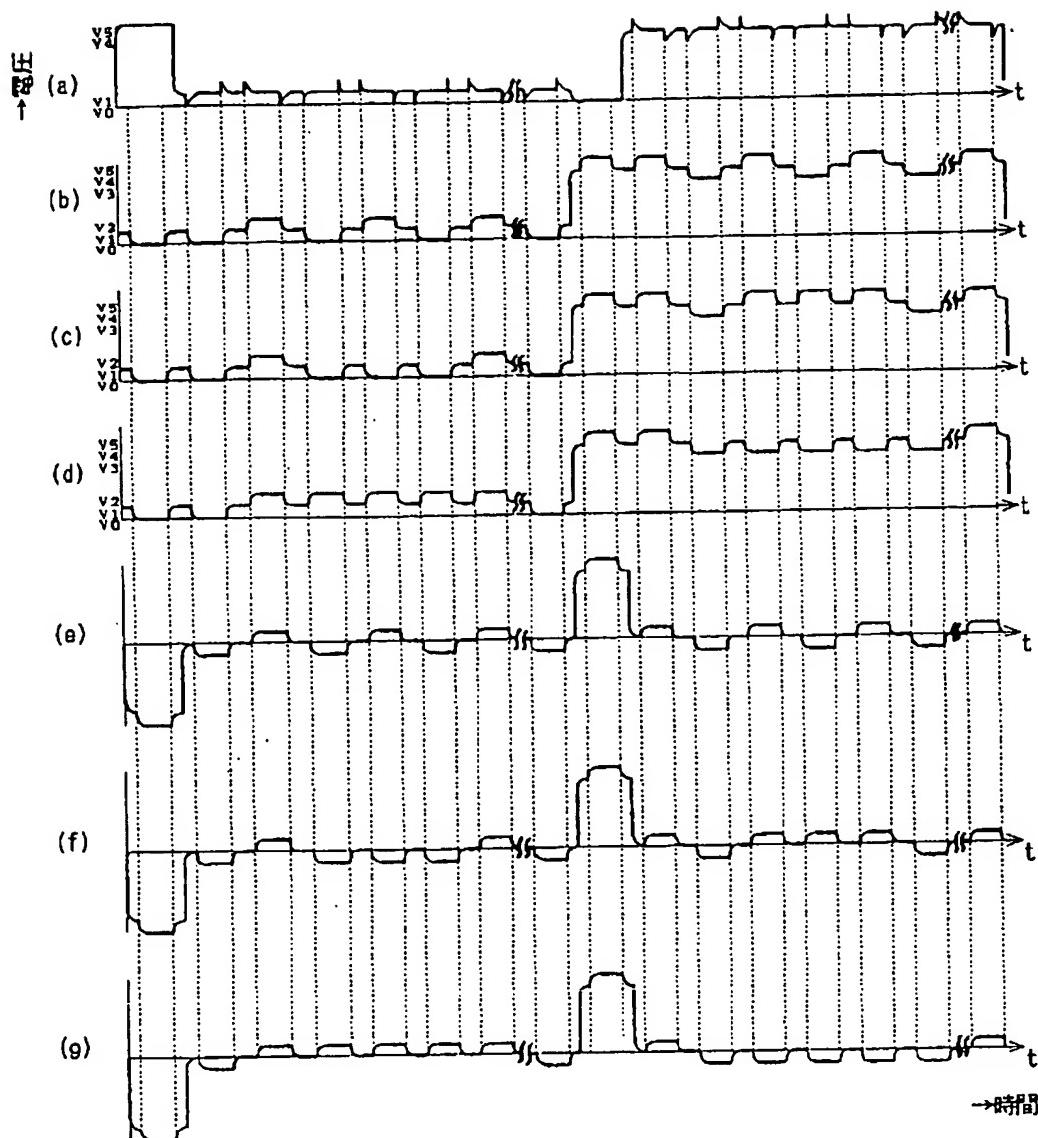
[Drawing 6]



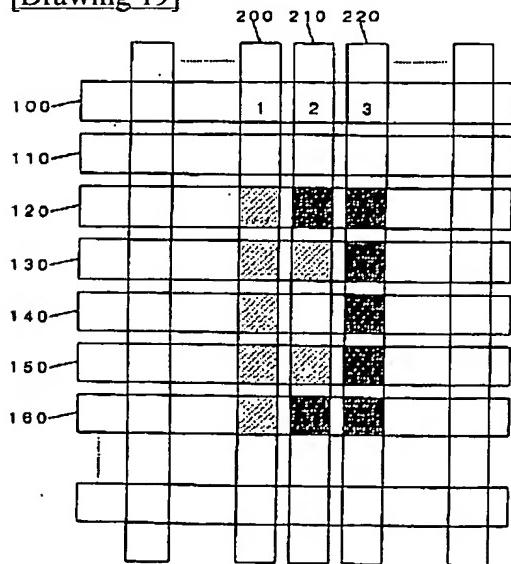
[Drawing 7]



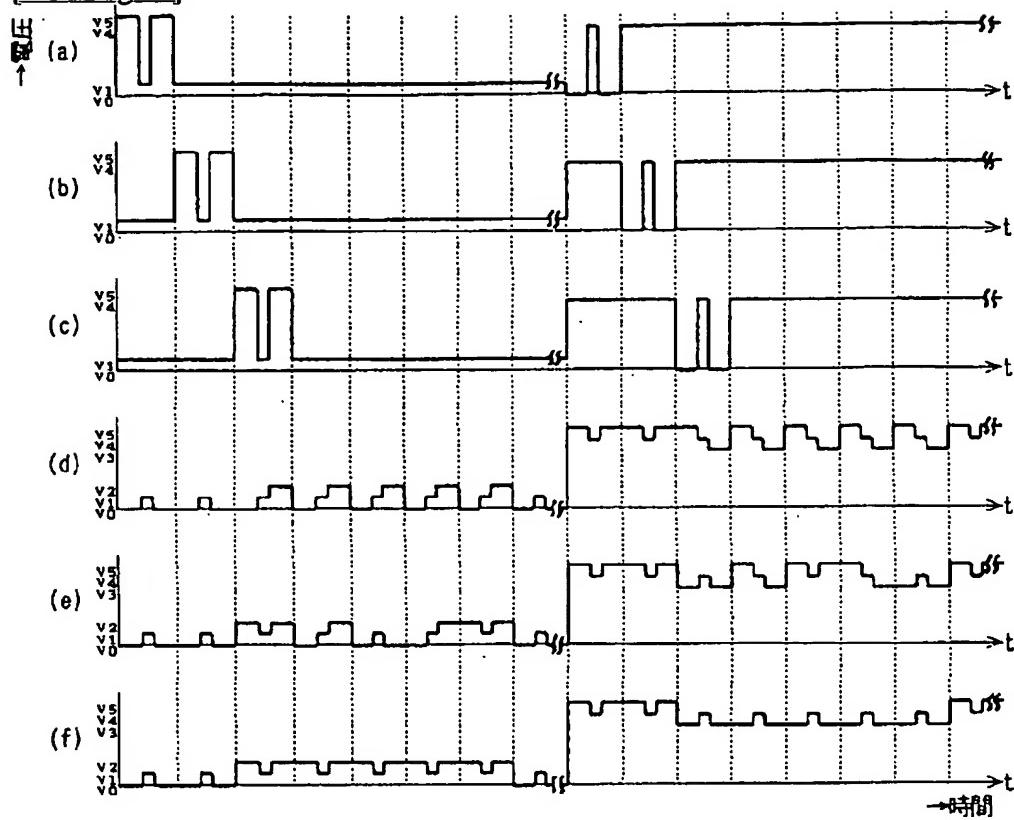
[Drawing 8]



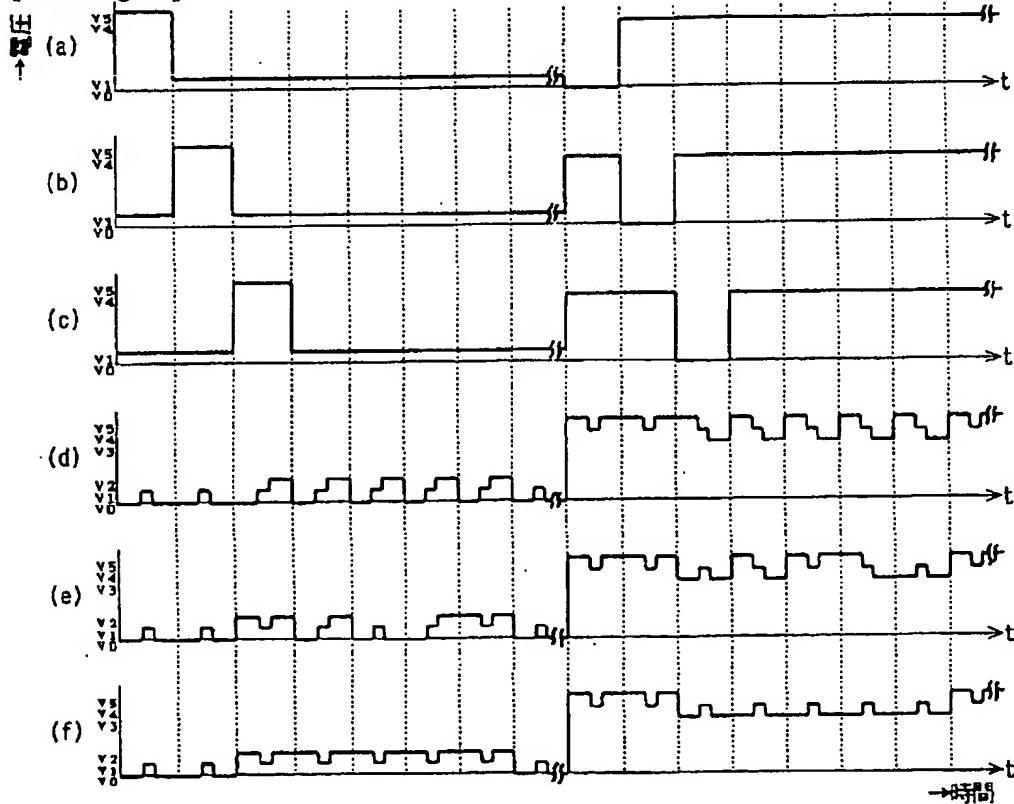
[Drawing 19]



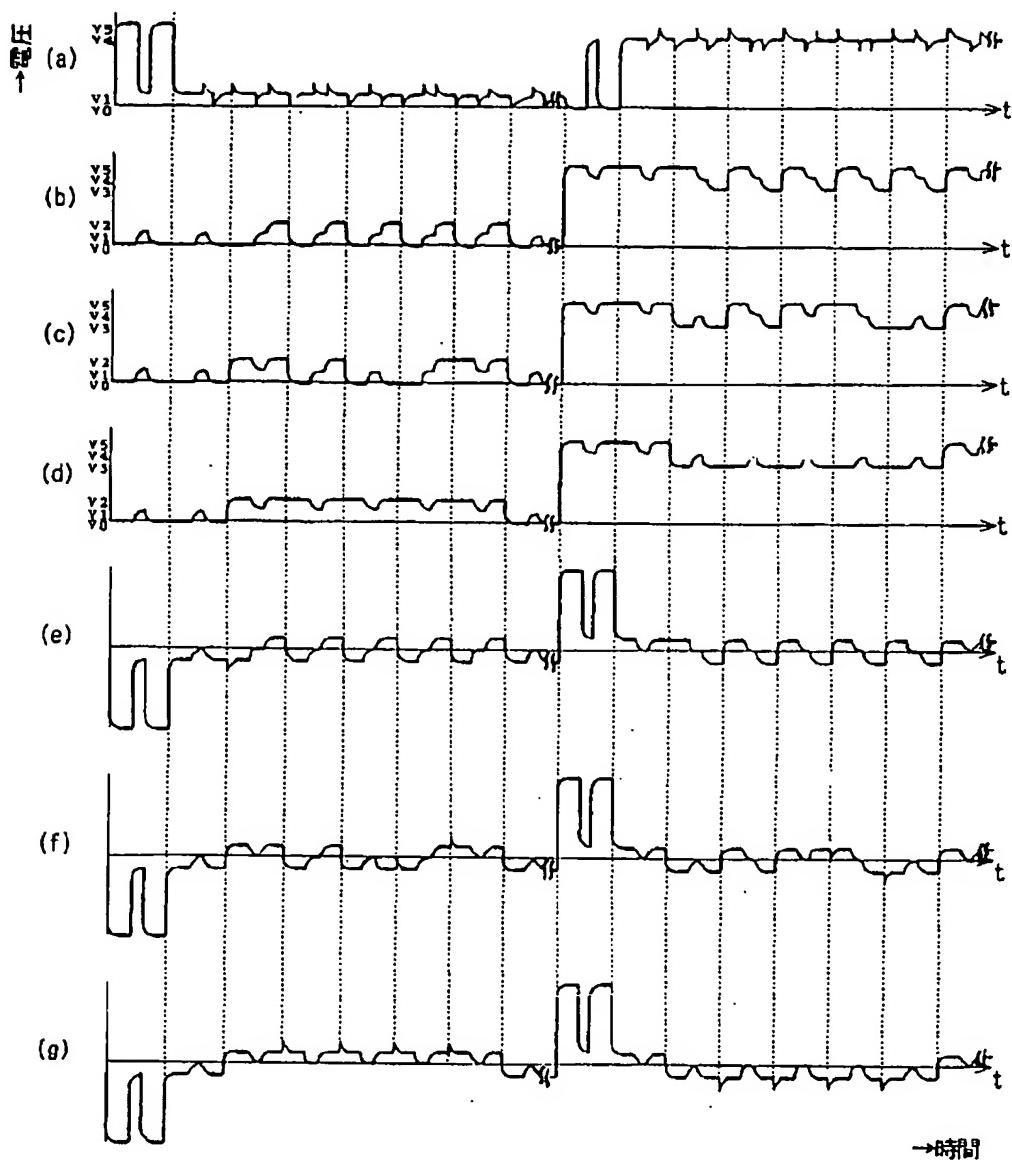
[Drawing 10]



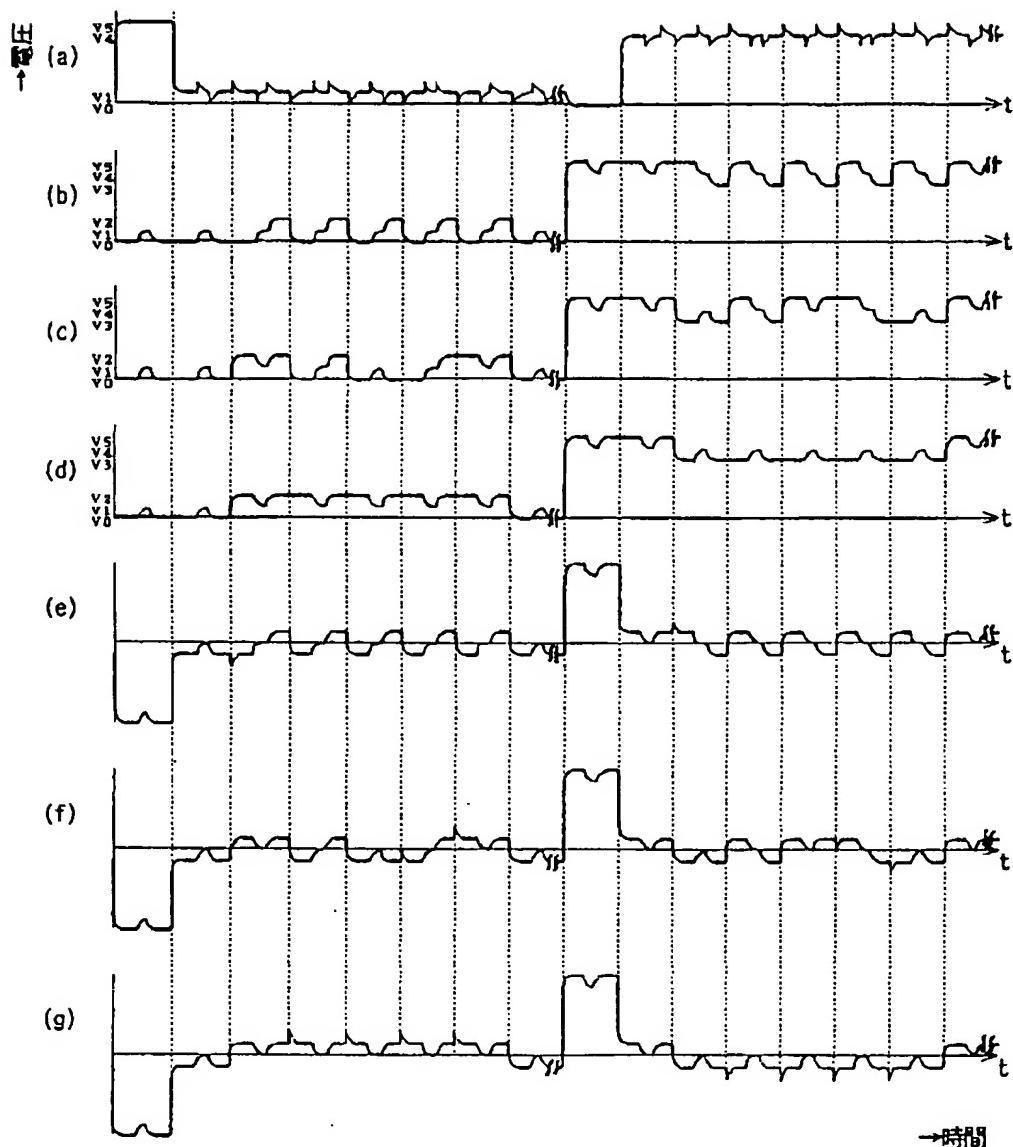
[Drawing 12]



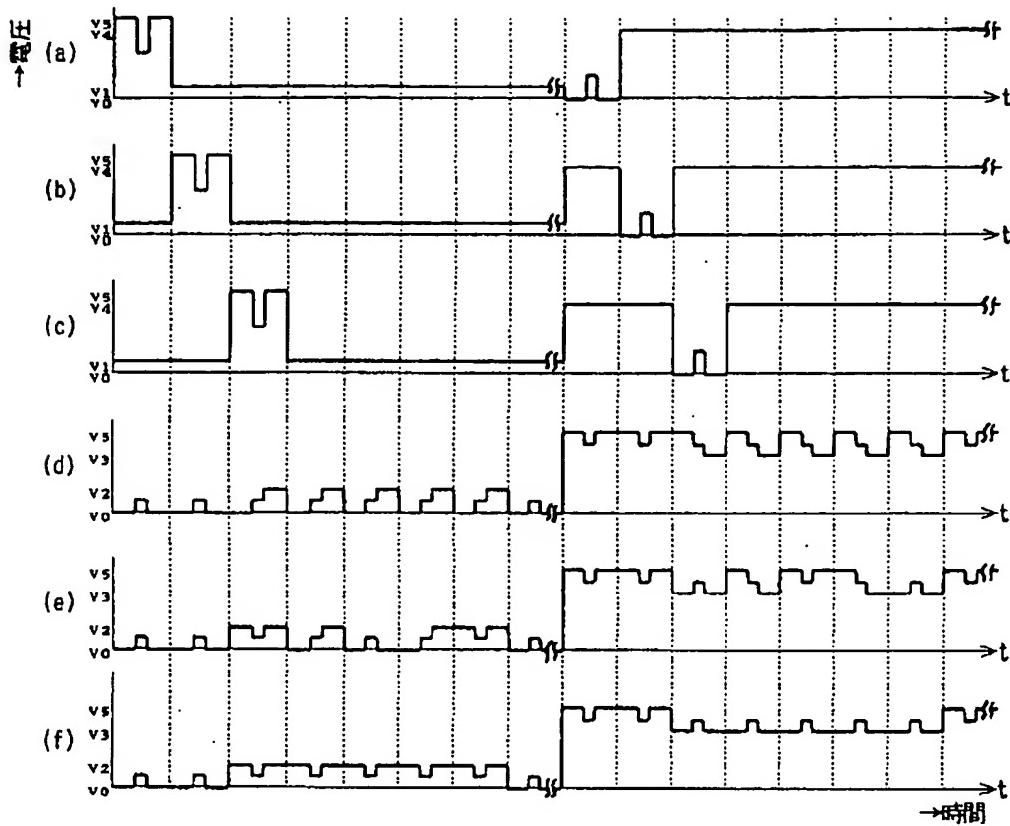
[Drawing 11]



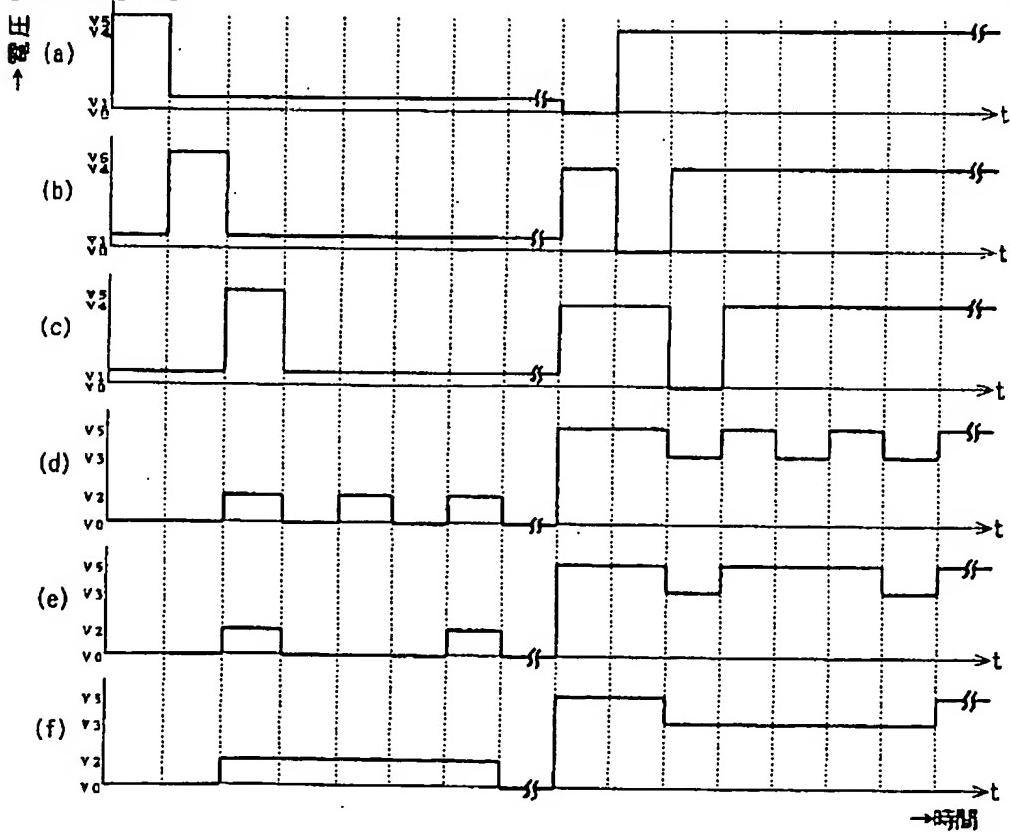
[Drawing 13]



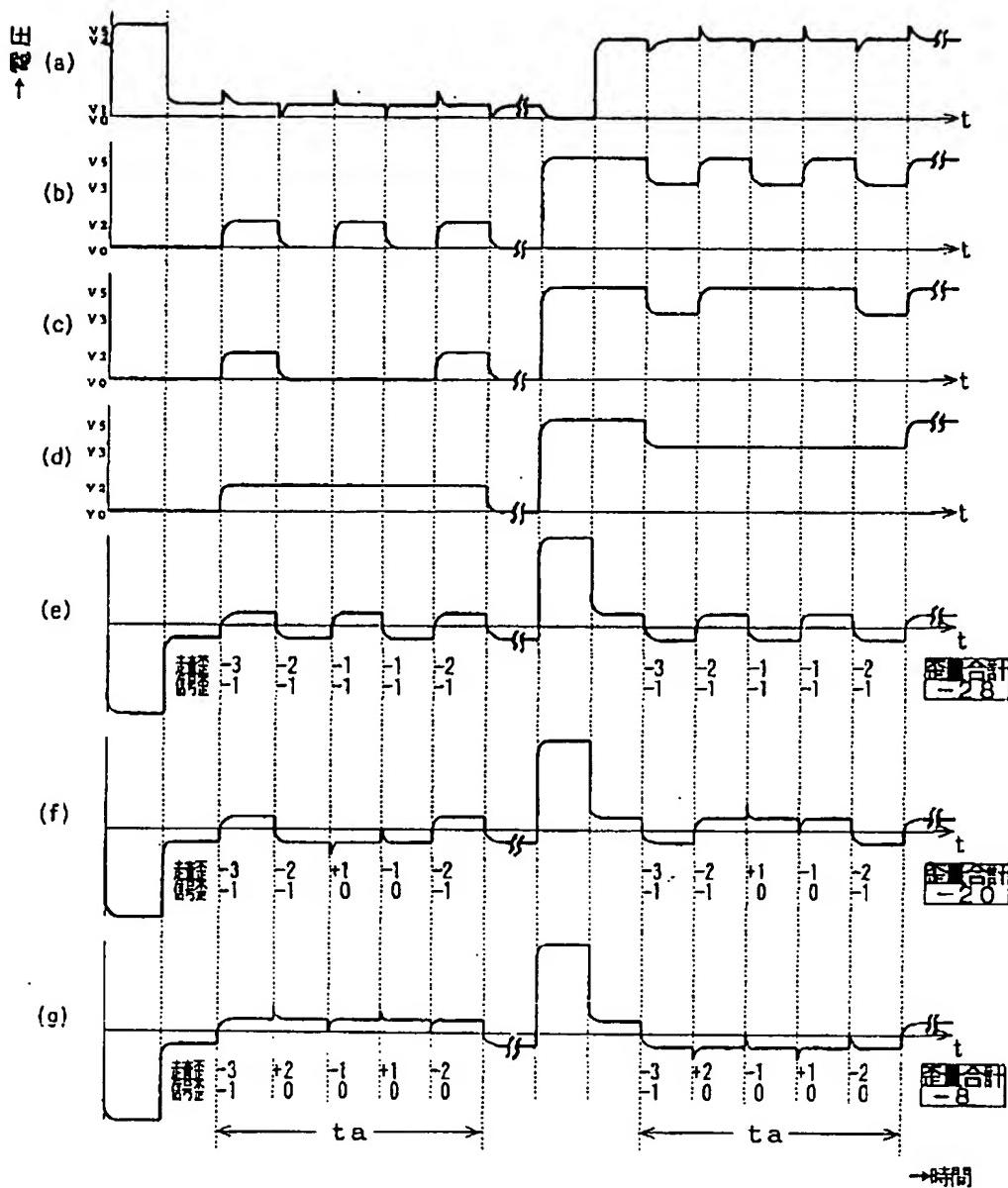
[Drawing 14]



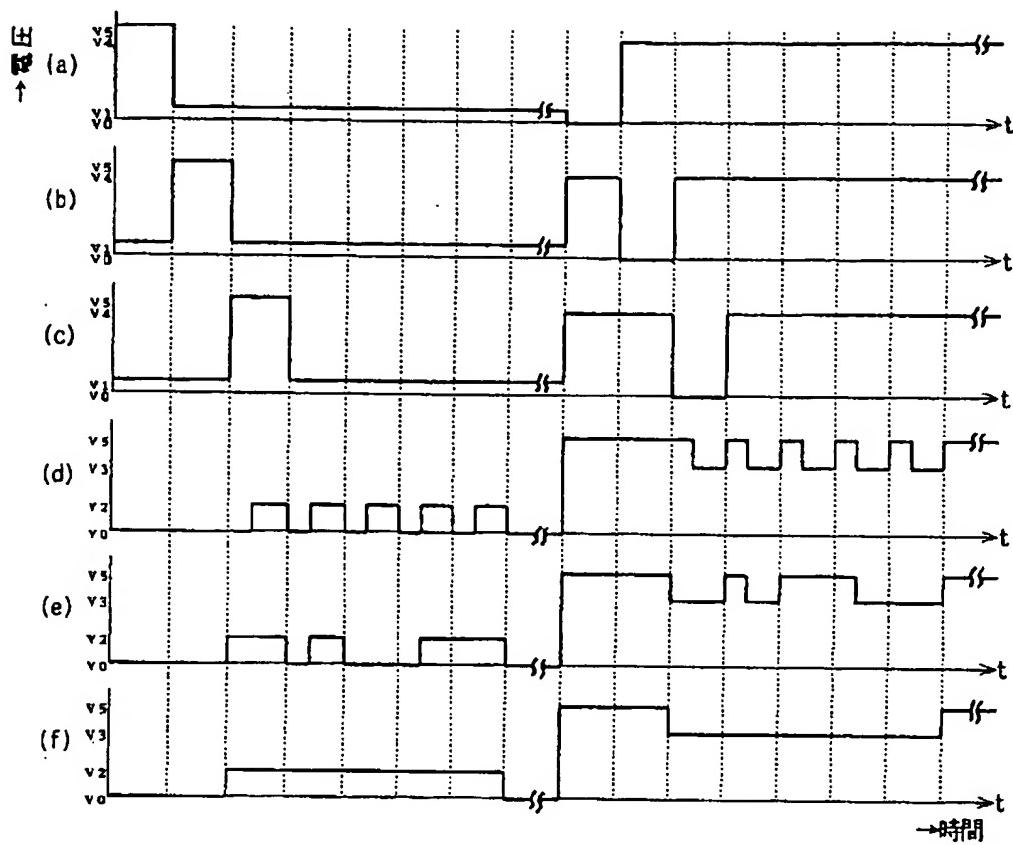
[Drawing 17]



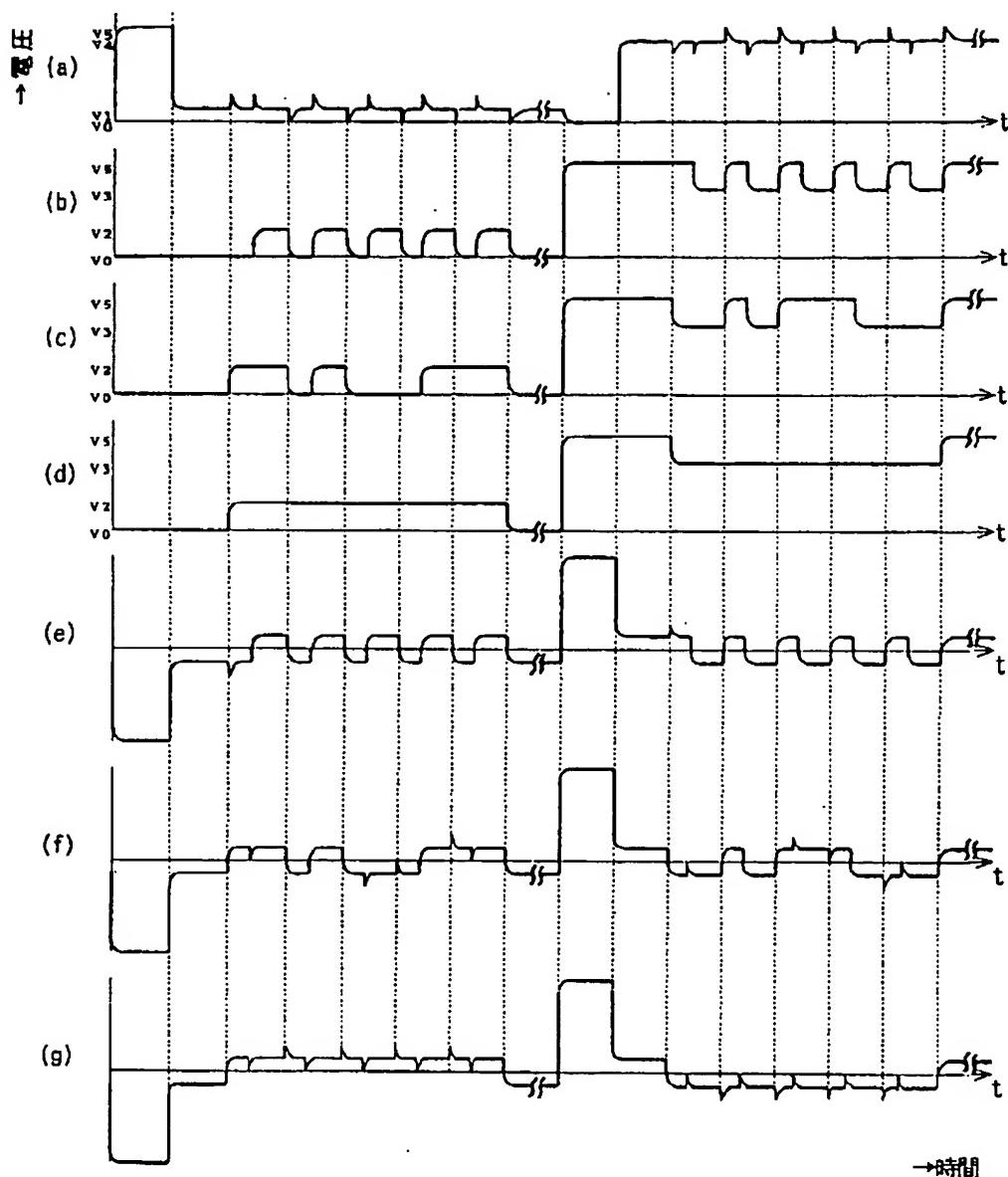
[Drawing 18]



[Drawing 20]



[Drawing 21]



[Translation done.]

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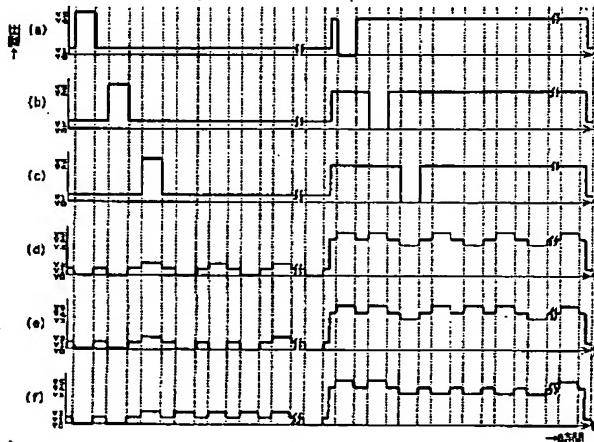
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(54)【発明の名称】 液晶表示装置の駆動方法

(57)【要約】

【目的】 表示パターンに関係なく、輝度むらの発生を抑制できる液晶表示装置の駆動方法を提供する。

【構成】 走査電極印加電圧に、(a)の走査パルスと(b)の走査パルスの間、(b)の走査パルスと(c)の走査パルスの間に非走査電圧(V1, V4)の期間(休止期間)を設けている。そして、信号電極印加電圧は、(d), (e), (f)に示すように、走査パルスと走査パルスとの間の期間で、表示データにかかわらず一旦走査電極駆動での非走査電圧と同電位になるような休止期間を持つ駆動波形を印加するようにしている。これにより、各信号電圧波形の切り替わり回数(周波数成分)はそれぞれ等しくなり、輝度むらが緩和される。



(2)

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【特許請求の範囲】

【請求項1】 信号電極群を設けた第1の基板と、前記信号電極群と交差配列した走査電極群を設けた第2の基板との間に、液晶を挟持したマトリクス型の液晶表示装置の駆動方法であって、

前記走査電極群に順次印加する走査パルスにおける第1の走査パルスとつぎの第2の走査パルスとの間に非走査電圧期間を設け、この非走査電圧期間に前記非走査電圧と同電圧を前記信号電極群に印加することを特徴とする液晶表示装置の駆動方法。

【請求項2】 信号電極群を設けた第1の基板と、前記信号電極群と交差配列した走査電極群を設けた第2の基板との間に、液晶を挟持したマトリクス型の液晶表示装置の駆動方法であって、

前記走査電極群に順次印加する走査パルスにおける第1の走査パルスを印加する第1の期間と前記第1の走査パルスのつぎの第2の走査パルスを印加する第2の期間とに跨る所定の期間に、前記非走査電圧と同電圧を前記信号電極群に印加することを特徴とする液晶表示装置の駆動方法。

【請求項3】 信号電極群を設けた第1の基板と、前記信号電極群と交差配列した走査電極群を設けた第2の基板との間に、液晶を挟持したマトリクス型の液晶表示装置の駆動方法であって、

前記走査電極群に順次印加する走査パルスにおける第1の走査パルスとつぎの第2の走査パルスとの間に非走査電圧期間を設け、この非走査電圧期間を跨ぐ所定の期間に前記非走査電圧と同電圧を前記信号電極群に印加することを特徴とする液晶表示装置の駆動方法。

【請求項4】 信号電圧の変化による走査電極の歪み電圧と同等な歪み電圧が発生する検出電極を走査電極群を設けた第2の基板に設け、前記検出電極に発生した歪み電圧をもとに前記走査電極群に電圧補正を行う請求項1, 2または3記載の液晶表示装置の駆動方法。

【請求項5】 走査電極上の給電・終電方向の1画素当たりの抵抗を5Ω以下とした液晶表示装置を駆動する請求項1, 2または3記載の液晶表示装置の駆動方法。

【請求項6】 パルス幅変調方式により中間調を表示するとともに、各走査期間の中程の所定の期間に非走査電圧と同電圧を信号電極群に印加することを特徴とする請求項1, 2または3記載の液晶表示装置の駆動方法。

【請求項7】 信号電圧の変化による走査電極の歪み電圧と同等な歪み電圧が発生する検出電極を走査電極群を設けた第2の基板に設け、前記検出電極に発生した歪み電圧をもとに前記走査電極群に電圧補正を行い、パルス幅変調方式により中間調を表示するとともに、各走査期間の中程の所定の期間に非走査電圧と同電圧を信号電極群に印加することを特徴とする請求項1, 2または3記載の液晶表示装置の駆動方法。

【請求項8】 走査電極上の給電・終電方向の1画素当

2

りの抵抗を5Ω以下とした液晶表示装置を駆動し、パルス幅変調方式により中間調を表示するとともに、各走査期間の中程の所定の期間に非走査電圧と同電圧を信号電極群に印加することを特徴とする請求項1, 2または3記載の液晶表示装置の駆動方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は、マトリクス型の液晶表示装置の駆動方法に関するものである。

【0002】

【従来の技術】従来のマトリクス型液晶表示装置の駆動方法としては、非選択期間に印加する実効電圧を一定にする電圧平均化法が一般的である（例えは特開昭50-68419号公報）。例えば、図15のパターンを表示した場合について説明する。図15において、1, 2, 3は画素、100, 110, 120, 130, 140, 150, 160は走査電極、200, 210, 220は信号電極であり、図中、走査電極と信号電極の交差部分（画素）における斜線部は黒表示、斜線のない部分は白表示を示す。図16は図15の走査電極100に関わる部分の等価回路を示している。また、図17は従来の電圧平均化法における印加電圧波形図で、(a),

(b), (c)はそれぞれ図15の走査電極100, 110, 120に印加する走査電極印加電圧波形図、同図(d), (e), (f)はそれぞれ信号電極200, 210, 220に印加する信号電極印加電圧波形図である。

【0003】走査電極と信号電極との交差点におけるそれぞれの電位差が各画素に印加される。画素のON（オン）/OFF（オフ）は信号電極印加電圧により決定し、これと走査電極印加電圧パルスとの差により、ON/OFF実効値をとる。

【0004】

【発明が解決しようとする課題】この従来の電圧平均化法においては、図17(d), (e), (f)に示すように表示パターンによって信号電極印加電圧波形が異なったものとなる。また実際に各画素に印加される電圧は、パネルの電極抵抗や液晶容量の影響のため、これらの異なった各信号電極印加電圧波形により複雑に歪んでしまう。このため印加すべき実効電圧とは異なった実効電圧が加わり、表示むらとなって画質が著しく低下してしまうという問題点を有していた。

【0005】次にその内容について説明する。図16の等価回路に示すようにノード101, 102, 103における走査電圧は、図18(a)に示すように、走査電極100の抵抗Rおよび画素容量Cにより信号電圧の変化時に歪みが生じる。ここで、ノード99と101の間の抵抗に比べ、ノード101と103の間の抵抗は小さく、101, 102, 103の電位はほぼ等しい。また、ノード201, 211, 221は図18(b),

(3)

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(c), (d) に示すように、信号電極の抵抗 r および画素容量 C により波形の歪みが生じる。このため、図 1 5 の画素 1, 2, 3 に印加される電圧は、図 1 8 (e), (f), (g) のようになり、同じ ON 実効値をとらなければいけないものが、実際は異なった実効値をとり、輝度むらの原因となる。この現象は、表示容量の増加に伴う駆動周波数の高周波化および電圧抵抗の増加等によってより顕著になる。

【0006】これらの歪量を計算するため、いま 1 つの信号電圧の変化による走査電圧の歪量および信号電圧の歪量をそれぞれ 1 単位と仮定すると、各表示データにより歪量が異なっている非選択期間 t_a における 2 フィールドでの画素電圧（走査側印加電圧 - 信号側印加電圧）歪量は、それぞれ -28, -20, -8 となり（歪量差最大 20）、本来同じ輝度であるべき画素 1, 2, 3 に印加される実効電圧は異なり、輝度むらが生じてしまう。

【0007】また、上記走査電圧の歪量を除去するためには走査電極の歪電圧を検出し、この検出された走査電圧歪量をもとに走査電圧に補正電圧をフィードバックする方法がある（例えば、特願 62-74607 号、また「単純マトリクス LCD のクロストーク表示むら低減のための新駆動法」、電子情報通信学会信学技報 1992, 41 ページ）。しかし、この方法では走査電圧の歪に起因する輝度むらは除去できるが、各信号電圧波形の切り替わり回数差（周波数成分差）に起因する輝度むらは完全には除去することができない。また次に、信号電圧波形の切り替わり回数差を均一化するために、1 走査期間（1 走査線を選択している期間）の整数倍で全駆動の極性を反転してやるという方法がある（例えば特開昭 60-19195 号公報）。しかしこの方法では、設定した極性反転周期によって走査線フリッカーが生じたり、またこれらを回避する極性反転周期にすると信号電圧波形の切り替わり回数差が表示パターンによっては均一にならなく、やはり輝度むらが生じる結果となっていた。

【0008】また、図 1 9 に示すような中間調表示を行う場合を考える。図 1 9において、図 1 5 と対応する部分には同一符号を付し、図中、走査電極と信号電極の交差部分（画素）における実線の斜線部は黒表示、点線の斜線部は中間調表示、斜線のない部分は白表示を示す。図 2 0 は図 1 9 に示すパターンを表示するため印加電圧波形図で、(a), (b), (c) はそれぞれ走査電極 100, 110, 120 に印加する走査電極印加電圧波形図、同図 (d), (e), (f) はそれぞれ信号電極 200, 210, 220 に印加する信号電極印加電圧波形図である。この場合の画素 1, 2, 3 の走査電極側の電圧波形を図 2 1 (a) に、画素 1, 2, 3 の信号電極側の電圧波形を図 2 1 (b), (c), (d) に、画素 1, 2, 3 に印加される電圧波形を図 2 1 (e),

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(f), (g) に示す。

【0009】図 2 0 に示すように、1 走査期間内において ON, OFF データを階調レベルに応じて切り換えることにより中間調を表示するパルス幅変調方式では、階調データにより信号波形が 1 走査期間内において切り替わる時と切り替わらない時が生じ、これによる周波数成分の違いから上記と同様、図 2 1 に示すように階調パターンにより各画素での電圧歪量が異なり、輝度むらが生じていた。

【0010】この発明の目的は、上記問題点を解決し、表示パターンに関係なく、輝度むらの発生を抑制できる液晶表示装置の駆動方法を提供することである。

【0011】

【課題を解決するための手段】請求項 1 記載の液晶表示装置の駆動方法は、走査電極群に順次印加する走査パルスにおける第 1 の走査パルスとつぎの第 2 の走査パルスとの間に非走査電圧期間を設け、この非走査電圧期間に非走査電圧と同電圧を信号電極群に印加することを特徴とする。

【0012】請求項 2 記載の液晶表示装置の駆動方法は、走査電極群に順次印加する走査パルスにおける第 1 の走査パルスを印加する第 1 の期間と第 1 の走査パルスのつぎの第 2 の走査パルスを印加する第 2 の期間とに跨がる所定の期間に、非走査電圧と同電圧を信号電極群に印加することを特徴とする。請求項 3 記載の液晶表示装置の駆動方法は、走査電極群に順次印加する走査パルスにおける第 1 の走査パルスとつぎの第 2 の走査パルスとの間に非走査電圧期間を設け、この非走査電圧期間に非走査電圧と同電圧を信号電極群に印加することを特徴とする。

【0013】請求項 4 記載の液晶表示装置の駆動方法は、請求項 1, 2 または 3 記載の液晶表示装置の駆動方法において、信号電圧の変化による走査電極の歪み電圧と同等な歪み電圧が発生する検出電極を走査電極群を設けた第 2 の基板に設け、検出電極に発生した歪み電圧をもとに走査電極群に電圧補正を行うものである。請求項 5 記載の液晶表示装置の駆動方法は、請求項 1, 2 または 3 記載の液晶表示装置の駆動方法において、走査電極上の給電・終電方向の 1 画素当たりの抵抗を 5 Ω 以下とした液晶表示装置を駆動するものである。

【0014】請求項 6 記載の液晶表示装置の駆動方法は、請求項 1, 2 または 3 記載の液晶表示装置の駆動方法において、パルス幅変調方式により中間調を表示するとともに、各走査期間の中程の所定の期間に非走査電圧と同電圧を信号電極群に印加することを特徴とする。請求項 7 記載の液晶表示装置の駆動方法は、請求項 1, 2 または 3 記載の液晶表示装置の駆動方法において、信号電圧の変化による走査電極の歪み電圧と同等な歪み電圧が発生する検出電極を走査電極群を設けた第 2 の基板に設け、検出電極に発生した歪み電圧をもとに走査電極群

(4)

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に電圧補正を行い、パルス幅変調方式により中間調を表示するとともに、各走査期間の中程の所定の期間に非走査電圧と同電圧を信号電極群に印加することを特徴とする。

【0015】請求項8記載の液晶表示装置の駆動方法は、請求項1、2または3記載の液晶表示装置の駆動方法において、走査電極上の給電・終電方向の1画素当りの抵抗を 5Ω 以下とした液晶表示装置を駆動し、パルス幅変調方式により中間調を表示するとともに、各走査期間の中程の所定の期間に非走査電圧と同電圧を信号電極群に印加することを特徴とする。

【0016】

【作用】液晶表示装置を駆動する際の電圧歪みにより生じる輝度むらには2つの原因が存在する。1つは各信号電圧波形の表示パターンによる切り替わり回数差(周波数成分差)による電圧歪差であり、もう1つは、信号電圧の変化による走査電圧の歪である。

【0017】この発明の駆動方法によれば、第1の走査パルスと第2の走査パルスの間、あるいは第1の走査パルスと第2の走査パルスを跨いだ期間に、走査電極群に印加する非走査電圧と同電圧を信号電極群に印加することにより、信号電圧による切り替わり回数差(周波数成分差)に起因する電圧歪差を表示パターンにかかわらず一定にし、大表示容量のパネルにおいても輝度むらの少ない高品位の表示を可能とすることができる。特に、第1の走査パルスと第2の走査パルスの間に、走査電極群に印加する非走査電圧と同電圧を信号電極群に印加する方法では、ON/OFF実効値比を従来と同等にとれるため、従来のコントラストを保持した状態で、輝度むらのない表示を可能とすることができる。

【0018】さらに、信号電圧の変化による走査電極の歪み電圧と同等な歪み電圧が発生する検出電極を設け、この検出電極に発生した歪み電圧をもとに走査電極群に電圧補正を行うこと、あるいは、走査電極上の給電・終電方向の1画素当りの抵抗を 5Ω 以下とすることにより、信号電極の電圧の変化による走査電極の電圧の歪量を大幅に軽減でき、上記2つの原因を同時に改善することにより2つの相乗効果が現れ、表示パターンによらず輝度むらのないより高品位の表示を可能とすることができます。

【0019】さらに、パルス幅変調方式により中間調を表示するとともに、各走査期間の中程の所定の期間に非走査電圧と同電圧を信号電極群に印加することにより、どんな中間調データによっても信号電圧の1走査期間内における切り替わり回数を同じとし、中間調表示を含めたあらゆる表示パターンにかかわらず、輝度むらのない高品位の表示を可能とすることができます。

【0020】

【実施例】

(第1の実施例)以下、この発明の第1の実施例の液晶

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表示装置の駆動方法について、図面を参照しながら説明する。図1および図2はこの発明の第1の実施例の液晶表示装置の駆動方法における電圧波形図で、図1の(a), (b), (c)はそれぞれ図15での走査電極100, 110, 120に印加する走査電極印加電圧波形図、図1(d), (e), (f)はそれぞれ信号電極200, 210, 220に印加する信号電極印加電圧波形図で、各画素にはそれぞれの電位差が印加される。図2(a)は図16のノード101, 102, 103における走査電圧波形、図2(b), (c), (d)はノード201, 211, 221における信号電圧波形、図2(e), (f), (g)は図15の画素1, 2, 3に印加される電圧波形を示す。

【0021】この実施例では、図17と18、図20と21に示す従来例同様、走査周期毎に印加電圧の極性を反転させている。すなわち、はじめの1走査周期では、図1(a), (b), (c)において、V0を基準電圧として、V5を走査電圧、V1を非走査電圧とし、図1(d), (e), (f)において、V0を基準電圧として、V2を選択電圧としている。つぎの1走査周期では、図1(a), (b), (c)において、V5を基準電圧として、V0を走査電圧、V4を非走査電圧とし、図1(d), (e), (f)において、V5を基準電圧として、V3を選択電圧としている。したがって、はじめの1走査周期とつぎの1走査周期では基準電圧に対するすべての電圧の極性が反転し、図2(e), (f), (g)に示すように、画素1, 2, 3に印加される電圧は2走査周期において完全な交流信号となっている。

【0022】さらにこの実施例では、走査電極印加電圧は図1(a), (b), (c)に示すように、(a)の走査パルスと(b)の走査パルスの間、(b)の走査パルスと(c)の走査パルスの間に非走査電圧(V1, V4)の期間(休止期間)を設けている。そして、信号電極印加電圧は図1(d), (e), (f)に示すように、走査パルスと走査パルスとの間の期間で、表示データにかかわらず一旦走査電極駆動での非走査電圧と同電位になるような休止期間を持つ駆動波形を印加するようしている。これにより、各信号電圧波形の切り替わり回数(周波数成分)はそれぞれ等しくなり、輝度むらが緩和される。

【0023】この実施例の駆動方法では図16のノード101, 102, 103における走査電圧は図2(a)のように歪み、ノード201, 211, 221における信号電圧は図2(b), (c), (d)となる。よって画素1, 2, 3に印加される電圧は図2(e), (f), (g)のように歪む。ここで従来例と同様に1回の信号電圧の変化による走査電圧の歪量および信号電圧の歪量を1単位とすると、各表示データにより歪量が異なっている非選択期間taにおける2フィールドでの電圧歪量はそれぞれ-11, -2, -9, -6, -8となる。

(5)

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り、従来例に比べそれぞれの画素での歪量差が小さくなるので（最大差3.1）、輝度むらも大きく改善される。

【0024】また、この実施例の駆動方法は従来の駆動方法に対し、画素1, 2, 3に印加される電圧は、図2(e), (f), (g)に示すように、休止期間に零電位が入っているのみである。よってON/OFF電圧実効値比は、従来の駆動方法における実効値比をほとんど保つことができ、従来のコントラストを保持した状態で、輝度むらを低減することができる。

【0025】このようにこの実施例の駆動方法では、各信号電圧波形の表示パターンによる切り替わり回数差（周波数成分差）に起因する電圧歪差を表示パターンにかかわらず一定とし、大表示容量のパネルにおいても輝度むらの少ない高品位の表示を可能とすることができる。なお、休止期間については、休止時間が少し存在するのみでも信号波形の切り替わり回数はどの信号パターンにおいても均一となるので、本発明の効果は現れ始め、輝度むらを改善することができる。また、休止期間については、液晶表示装置の各信号ラインの持つ抵抗と容量で決まる時定数による駆動波形切り替わり時のなり方により効果が異なる。いま、駆動波形切り替わり時の画素に印加される信号電極側電位を0%とし、波形切り替わり後十分時間の経過した定常状態における画素に印加される信号電極側電位を100%としたとき、波形切り替わり後、画素に印加される信号電極側電位が50%に変化した時点までの期間を休止期間とし、実際のパネルで評価を行ったところ、その効果は十分認められた。そして、波形切り替わり後、画素に印加される信号電極側電位が100%以上になった時点までの期間を休止期間とすることにより、信号電極側の画素電圧に及ぼす影響は、どのような表示パターンに対応する駆動を行っても等しくなり、ほとんど輝度むらは観測されなかつた。したがって、休止期間の設定において、少しでも休止期間を設定することにより本発明の効果は現れる始めるが、上記50%以上の期間を設定することにより効果は良くなり、上記100%以上の期間を設定することにより、その効果は特に良くなる。

【0026】また、この実施例では液晶表示モードがしきい値特性が急峻なSTN(Super-Twisted-Nematic)モードにおいて特にその効果を大きく発揮できるが、この第1の実施例以下第5の実施例まで、この発明の駆動方法は液晶の表示モードにかかわらず、対向面に走査電極群と信号電極群を有する一対の基板間に液晶を挟持した液晶表示パネルであれば、その他のモードを用いた液晶表示装置でもこの発明の駆動方法を用いることにより、実施例同様、画素駆動電圧歪による輝度むらを改善することができる。これに関しては例えば、TN(Twisted-Nematic)モード、電界効果複屈折モード等が挙げられる。

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【0027】(第2の実施例)以下、この発明の第2の実施例の液晶表示装置の駆動方法について、図面を参照しながら説明する。この実施例における走査電極印加電圧波形図および信号電極印加電圧波形図は図1に示す第1の実施例と同様である。しかしこの実施例では、液晶表示装置における走査電極に、信号電圧の変化による走査電圧の歪を除去するための回路を附加している。この実施例における液晶表示装置の回路構成を図3に示す。図3において、10は液晶パネル、11は走査電極、12は信号電極、13は走査ドライバ、14は信号ドライバ、15は検出電極、16は検出回路、17は補正電圧発生回路、18は制御回路、19は駆動電圧発生回路である。図5はこの第2の実施例における電圧波形図であり、図2と同様、図5(a)は図16のノード101, 102, 103における走査電圧波形、図5(b), (c), (d)はノード201, 211, 221における信号電圧波形、図5(e), (f), (g)は図15の画素1, 2, 3に印加される電圧波形を示す。

【0028】マトリクス型の液晶表示装置では、信号ドライバ14によって供給される信号電極印加電圧は、信号電圧切り替わり時ににおいて、液晶によるカップリングのため、走査電極11上に歪み電圧が発生する。この実施例では、走査電極側の基板に、走査電極11と同様な検出電極15を附加することにより、走査電極11と同様に検出電極15にも歪み電圧が発生する。この検出電極15に発生した歪み電圧を、例えばオペアンプの入力端子等で構成された検出回路16により検出し、この検出電圧を増幅して逆位相にさせる補正電圧発生回路17を通してとの走査ドライバ13の駆動電圧ラインに加えてやるといった方式を用いることにより、走査電極11上に発生する電圧歪みを抑えることができる。

【0029】なお、この方式は、信号電極印加電圧の切り替わり時に走査電極11上に発生する電圧歪みを検出し、それをもとに走査電極11に電圧を補正を行う一例であり、走査電極11上に発生する電圧歪みを補正できる方式であれば、どのような方式を用いても構わない。この方式により、信号電圧の変化による走査電極の歪量は、図5(a)のように図2(a)の第1の実施例に比べて軽減され、1回の信号電圧の切り替わりによる走査電圧の歪量は第1の実施例の1単位から0.1単位程度まで低減される。従来例と同様に計算を行うと、画素1, 2, 3に印加される電圧は図5(e), (f), (g)であり、各非選択期間taにおける2フィールドでの第2の実施例の電圧歪量はそれぞれ-4.7, -4.6, -4.4となり、歪量の差は僅か0.3とほとんど差がなくなる。

【0030】またこれに対し、従来の駆動方法で単に信号電圧の変化による走査電圧の歪を除去する方法を用いたのみでは、画素1, 2, 3に印加される電圧の非選択期間taにおける2フィールドでの電圧歪量はそれぞれ

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-11.8, -7.4, -2.6 であり、歪量の差は 9.2 となり、これでは輝度むらはあまり改善されない。この原因は、走査電圧の歪を除去するのみでは、信号電極駆動電圧波形の切り替わり回数差（周波数成分差）による歪量の差は改善されないためである。しかし、この第2の実施例のように、第1の実施例の駆動方法と走査電極上の歪電圧を除去する方法とを併用することによって、2つの方法の相乗効果が出て、作用で述べた輝度むらの原因の双方を同時に改善することができ、輝度むらが大きく改善される。

【0031】なお、図3では、検出電極15を信号電極12の給電側に設けているが、終電側に設けても上記同様の効果を得ることができる。また、走査電極上に乗る歪電圧は、信号電極側から見た給電側と終電側で違ひがあるため、図4に示すように、信号電極12の給電側と終電側の両方に検出電極15を設け、この2つの検出電極15からの検出により補正電圧を求める、さらに精度よく歪電圧を除去することができる。また、補正方法に関してはこの第2の実施例に示すもののみならず、信号電圧変化による走査電圧の歪が除去されるものであれば、第2の実施例同様、第1の実施例における駆動方法との相乗効果が現れ、作用で述べた輝度むらの原因の双方を同時に改善することができ、輝度むらを大きく改善することができる。

【0032】なお、図3、図4における検出電極15は、走査電極11の一部を検出電極の代わりとして用いても構わない。

(第3の実施例) 以下、この発明の第3の実施例の液晶表示装置の駆動方法について、図面を参照しながら説明する。

【0033】この実施例は、第1の実施例では走査電極のシート抵抗が $10\Omega/\square$ であり、走査電極上の給電側から終電側に向かう方向の1画素当りの抵抗が 10Ω であったものを、走査電極に並設したA1などの金属の補助配線により1画素当りの抵抗が 1Ω となるまで下げたものである。走査電極印加電圧波形図および信号電極印加電圧波形図は図1に示す第1の実施例と同様である。図6はこの第3の実施例における電圧波形図であり、図2と同様、図6(a)は図16のノード101, 102, 103における走査電圧波形、図6(b), (c), (d)はノード201, 211, 221における信号電圧波形、図6(e), (f), (g)は図15の画素1, 2, 3に印加される電圧波形を示す。

【0034】この実施例の走査電極低抵抗化により、信号電圧の変化による走査電圧の歪量は図6(a)に示すように、図2(a)で示される第1の実施例に比べて大幅に軽減され、1回の信号電圧の切り替わりによる走査電圧の歪量は従来例の1単位から0.3単位程度まで低減される。同様に計算を行うと、画素1, 2, 3に印加される電圧は図6(e), (f), (g)であり、非選

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択期間 t_a における2フィールドでの電圧歪量はそれぞれ -6.4, -5.9, -5.3 となり、歪量は従来に比べて小さく、また差もかなり小さい（最大差 1.1）。

【0035】またこれに対し、従来の駆動方法で単に補助電極のみを用い、1画素当りの抵抗を 1Ω にするのみでは、画素1, 2, 3に印加される電圧の非選択期間 t_a における2フィールドでの電圧歪量はそれぞれ -16, -10.6, -4 であり、歪量の差は 1.2 となり、これでは輝度むらが生じる。この原因も第2の実施例同様、信号電極駆動電圧波形の切り替わり回数差（周波数成分差）による歪量の差が改善されていないためである。よって、単に走査電極抵抗を低抵抗化しても信号電極側の波形の周波数成分は変わらず、輝度むらはあまり改善されない。しかし、この第3の実施例のように、第1の実施例の駆動方法と走査電極低抵抗化とを併用することによって、2つの方法の相乗効果が現れ、輝度むらを大きく改善することができる。またこの走査電極低抵抗化は、走査電極上の給電・終電方向の1画素当りの抵抗が 5Ω 以下で、第1の実施例に対して特に効果が現れ、さらに、 1Ω 以下であれば上記に示したようにほとんど輝度むらは生じなくなる。

【0036】なお、この実施例では、金属補助配線を用いた走査電極低抵抗化の方法を用いたが、この方法のみならず、単なるITO電極低抵抗化等、走査電極低抵抗化の方法であれば、この実施例同様、各画素に印加される駆動電圧波形歪量の差を低減する事ができ、輝度むらを大きく改善することができる。

(第4の実施例) 以下、この発明の第4の実施例の液晶表示装置の駆動方法について、図面を参照しながら説明する。

【0037】図7はこの発明の第4の実施例の液晶表示装置の駆動方法における印加電圧波形図であり、図7(a), (b), (c) はそれぞれ図15での走査電極100, 110, 120に印加する走査電極印加電圧波形、図7(d), (e), (f) はそれぞれ信号電極200, 210, 220に印加する信号電極印加電圧波形を示す。図8はこの第4の実施例における電圧波形図であり、図2と同様、図8(a)は図16のノード101, 102, 103における走査電圧波形、図8(b), (c), (d)はノード201, 211, 221における信号電圧波形、図8(e), (f), (g)は図15の画素1, 2, 3に印加される電圧波形を示す。

【0038】第1～第3の実施例では駆動電圧波形の休止期間を、信号電極駆動・走査電極駆動共、走査パルスと走査パルスの間に設けていたが、この第4の実施例では、図7に示すように、信号電極駆動のみに休止期間を設定し、これが2つの走査期間にまたがった形となつている。信号電極を駆動する切り替わり回数差をパターン

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に依存せず一定にするという原理は第1の実施例と全く同じであるが、この実施例では第1の実施例の駆動方法に比べ、液晶パネルを駆動するICの耐圧を低くできる特徴を持っている。

【0039】第1の実施例の方法では、画素電圧波形は図2(e), (f), (g)に示されるように従来の画素電圧波形(図18(e), (f), (g))に比べ、休止期間が入っているため、画素に印加される電圧実効値が低下してしまう。このため、液晶を駆動するためにパルス電圧を従来よりも高く設定しなければいけなくなり、駆動用ICの耐圧も高いものにしなければならない。しかし、この実施例では図8(e), (f), (g)に示すように、選択パルスの両端期間にONパルスとOFFパルスの中間の電圧が加わった形となるので、実効値低下を抑えることができ、駆動ICの耐圧も低く抑えることができる。

【0040】この駆動方法では、画素を駆動する電圧のON/OFF実効値比が従来例および第1の実施例に対し、低いものとなってしまうので、図9に示すように、走査電圧の休止期間を第1の実施例に示したものより短くして、信号電圧の休止期間を2つの走査期間にまたがって設定することにより、駆動IC耐圧に応じた最適な駆動方法を得ることができる。なお、図9(a),

(b), (c)はそれぞれ図15での走査電極100, 110, 120に印加する走査電極印加電圧波形、図9(d), (e), (f)はそれぞれ信号電極200, 210, 220に印加する信号電極印加電圧波形を示す。

【0041】また、この実施例の駆動方法においても第2, 第3の実施例と同様、信号電圧変化による走査電圧の歪を除去する方法と組み合わせることにより、輝度むらを大きく改善することができる。

(第5の実施例)以下、この発明の第5の実施例の液晶表示装置の駆動方法について、図面を参照しながら説明する。

【0042】図10は図18に示す中間調表示をパルス幅変調方式により行った場合のこの実施例における電極印加電圧波形を示している。であり、図10(a), (b), (c)はそれぞれ図19での走査電極100, 110, 120に印加する走査電極印加電圧波形、図10(d), (e), (f)はそれぞれ信号電極200, 210, 220に印加する信号電極印加電圧波形を示す。図11はこの第4の実施例における電圧波形図であり、図2と同様、図11(a)は図16のノード101, 102, 103における走査電圧波形、図11(b), (c), (d)はノード201, 211, 221における信号電圧波形、図11(e), (f), (g)は図19の画素1, 2, 3に印加される電圧波形を示す。

【0043】この実施例のように中間調表示パターンの場合、図10に示すように、走査電極印加電圧および信

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号電極印加電圧に、非走査電圧と同電位になる休止期間を各走査期間の中に設けている。これにより、画素電圧は図11(e), (f), (g)のようになる。この方法を用いることにより、どの中間調データに対しても上記実施例同様、信号電極駆動電圧波形の反転回数差(周波数成分差)による歪量の差が小さくなる。

【0044】また、第2, 第3の実施例と同様、信号電圧の変化による走査電圧の歪みを除去するような方法を併用することにより、輝度むらを大きく改善させることができるのも同様である。従来でのパルス幅変調における中間調表示では中間調データにより、信号波形が1走査期間内において切り替わる場合と切り替わらない場合が生じ、これにより信号切り替わり回数による波形歪みの回数が異なることから、2値表示での表示パターンの切り替わりの場合と同様のメカニズムにより輝度むらが生じていた。しかしこの実施例によれば、あらゆる中間調データにかかわらずこの切り替わり回数を同じものとし、輝度むらのない均一な液晶表示装置を得ることができる。

【0045】またこの方法に関しても、第1の実施例と同様に画素を駆動する電圧のON/OFF実効値比は保つ方式であるが、画素にかかる電圧実効値は従来に対して小さなものとなり、液晶パネルの駆動ICの耐圧は高いものにしなければならない。このため、図10(a), (b), (c)に示す所の走査電圧パルスの休止期間をなくし、図12(a), (b), (c)に示すような駆動波形を用いると、画素印加電圧波形は図13(e), (f), (g)のようになり実効値の低下を抑え、駆動ICの耐圧を抑えることができる。なお、図12(a)～(f)は図10の(a)～(f)同様、走査電極印加電圧および信号電極印加電圧の波形を示し、図13(a)～(g)は図11の(a)～(g)同様、走査電圧波形、信号電圧波形および図19の画素1, 2, 3に印加される電圧波形を示す。

【0046】また、図12, 図13に示す方法に関するも画素のON/OFF電圧実効値比が従来より小さくなってしまう。ここで、図14に示すような図10と図12の中間となる駆動方法、すなわち休止期間における走査電極印加電圧を走査電圧と非走査電圧との中間の電圧を印加する方法を用いることにより、液晶駆動ICの耐圧に応じた最適な駆動方法を得ることができる。なお、図14(a)～(f)は図10の(a)～(f)同様、走査電極印加電圧および信号電極印加電圧の波形を示す。

【0047】また、この実施例に示す駆動方法のみでは中間調データによる電圧歪量の差を除去できるが、表示パターンの切り替わりによる電圧歪は従来のように発生し、輝度むらが生じる。よってこれを改善するため、第1～第4の実施例の駆動方法とこの第5の実施例の駆動方法とを組み合わせることにより、中間調表示を含めた

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あらゆる表示パターンにかかわらず、輝度むらのない高品位の表示を可能とすることができます。

【0048】なお、本発明は、信号電圧の歪み量を表示パターンにかかわらず一定とするものであり、信号電極印加電圧の歪み量が表示パターンにより異なる、すなわち表示パターンにより信号電極印加電圧波形が切り替わるものと切り替わらないものとが存在する駆動方法であれば、本発明の駆動方法を適用することにより、輝度むらを改善することができる。また、上記実施例では、走査周期毎に、基準電圧（V0, V5）に対する走査電極印加電圧と信号電極印加電圧の極性を反転させ、画素に印加される電圧が2走査周期において完全な交流信号となるような駆動方法を用いたが、この極性反転周期がどのような周期であっても、本発明の駆動方法を用いることにより輝度むらを改善することができる。

【0049】

【発明の効果】以上のようにこの発明の液晶表示装置の駆動方法は、第1の走査パルスと第2の走査パルスの間、あるいは第1の走査パルスと第2の走査パルスを跨いだ期間に、走査電極群に印加する非走査電圧と同電圧を信号電極群に印加することにより、信号電圧による切り替わり回数差（周波数成分差）に起因する電圧歪差を表示パターンにかかわらず一定にし、大表示容量のパネルにおいても輝度むらの少ない高品位の表示を可能とすることができます。特に、第1の走査パルスと第2の走査パルスの間に、走査電極群に印加する非走査電圧と同電圧を信号電極群に印加する方法では、ON/OFF実効値比を従来と同等にとれるため、従来のコントラストを保持した状態で、輝度むらのない表示を可能とすることができます。さらに、信号電圧の変化による走査電極の歪み電圧と同等な歪み電圧が発生する検出電極を設け、この検出電極に発生した歪み電圧をもとに走査電極群に電圧補正を行うこと、あるいは、走査電極上の給電・終電方向の1画素当りの抵抗を5Ω以下とすることにより、信号電極の電圧の変化による走査電極の電圧の歪量を大幅に軽減でき、表示パターンによらず輝度むらのないより高品位の表示を可能とすることができます。

【0050】さらに、パルス幅変調方式により中間調を表示するとともに、各走査期間の中程の所定の期間に非走査電圧と同電圧を信号電極群に印加することにより、どんな中間調データによっても信号電圧の1走査期間内における切り替わり回数と同じとし、中間調表示を含めたあらゆる表示パターンにかかわらず、輝度むらのない高品位の表示を可能とすることができます。

【図面の簡単な説明】

【図1】(a), (b), (c)はこの発明の第1の実施例の液晶表示装置の駆動方法における走査電極印加電圧波形図、(d), (e), (f)は同実施例における信号電極印加電圧波形図。

【図2】(a)はこの発明の第1の実施例の液晶表示装

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置の駆動方法における画素の走査電極側の電圧波形の概略図、(b), (c), (d)は同実施例における画素の信号電極側の電圧波形の概略図、(e), (f), (g)は同実施例における画素に印加される電圧波形の概略図。

【図3】この発明の第2の実施例の液晶表示装置の駆動方法における液晶表示装置のブロック図。

【図4】この発明の第2の実施例の液晶表示装置の駆動方法における液晶表示装置のブロック図。

【図5】(a)はこの発明の第2の実施例の液晶表示装置の駆動方法における画素の走査電極側の電圧波形の概略図、(b), (c), (d)は同実施例における画素の信号電極側の電圧波形の概略図、(e), (f), (g)は同実施例における画素に印加される電圧波形の概略図。

【図6】(a)はこの発明の第3の実施例の液晶表示装置の駆動方法における画素の走査電極側の電圧波形の概略図、(b), (c), (d)は同実施例における画素の信号電極側の電圧波形の概略図、(e), (f), (g)は同実施例における画素に印加される電圧波形の概略図。

【図7】(a), (b), (c)はこの発明の第4の実施例の液晶表示装置の駆動方法における走査電極印加電圧波形図、(d), (e), (f)は同実施例における信号電極印加電圧波形図。

【図8】(a)はこの発明の第4の実施例の液晶表示装置の駆動方法における画素の走査電極側の電圧波形の概略図、(b), (c), (d)は同実施例における画素の信号電極側の電圧波形の概略図、(e), (f), (g)は同実施例における画素に印加される電圧波形の概略図。

【図9】(a)はこの発明の第4の実施例の液晶表示装置の駆動方法における画素の走査電極側の電圧波形の概略図、(b), (c), (d)は同実施例における画素の信号電極側の電圧波形の概略図、(e), (f), (g)は同実施例における画素に印加される電圧波形の概略図。

【図10】(a), (b), (c)はこの発明の第5の実施例の液晶表示装置の駆動方法における走査電極印加電圧波形図、(d), (e), (f)は同実施例における信号電極印加電圧波形図。

【図11】(a)はこの発明の第5の実施例の液晶表示装置の駆動方法における画素の走査電極側の電圧波形の概略図、(b), (c), (d)は同実施例における画素の信号電極側の電圧波形の概略図、(e), (f), (g)は同実施例における画素に印加される電圧波形の概略図。

【図12】(a), (b), (c)はこの発明の第5の実施例の液晶表示装置の駆動方法における走査電極印加電圧波形図、(d), (e), (f)は同実施例におけ

(9)

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る信号電極印加電圧波形図。

【図13】(a)はこの発明の第5の実施例の液晶表示装置の駆動方法における画素の走査電極側の電圧波形の概略図、(b)、(c)、(d)は同実施例における画素の信号電極側の電圧波形の概略図、(e)、(f)、(g)は同実施例における画素に印加される電圧波形の概略図。

【図14】(a)はこの発明の第5の実施例の液晶表示装置の駆動方法における画素の走査電極側の電圧波形の概略図、(b), (c), (d)は同実施例における画素の信号電極側の電圧波形の概略図、(e), (f), (g)は同実施例における画素に印加される電圧波形の概略図。

【図15】マトリクス型液晶表示パネルの表示パターン図。

【図16】マトリクス型液晶表示パネルの1つの走査電極に關わる箇箇回路図。

【図17】(a), (b), (c)は従来の液晶表示装置の駆動方法における走査電極印加電圧波形図

(d), (e), (f) は同駆動方法における信号電極印加電圧波形図

【図18】(a)は従来の液晶表示装置の駆動方法における画素の走査電極側の電圧波形の概略図、(b)、(c)、(d)は同駆動方法における画素の信号電極側の電圧波形の概略図、(e)、(f)、(g)は同駆動方法における画素に印加される電圧波形の概略図。

【図19】マトリクス型液晶表示パネルの中間調表示パターン図

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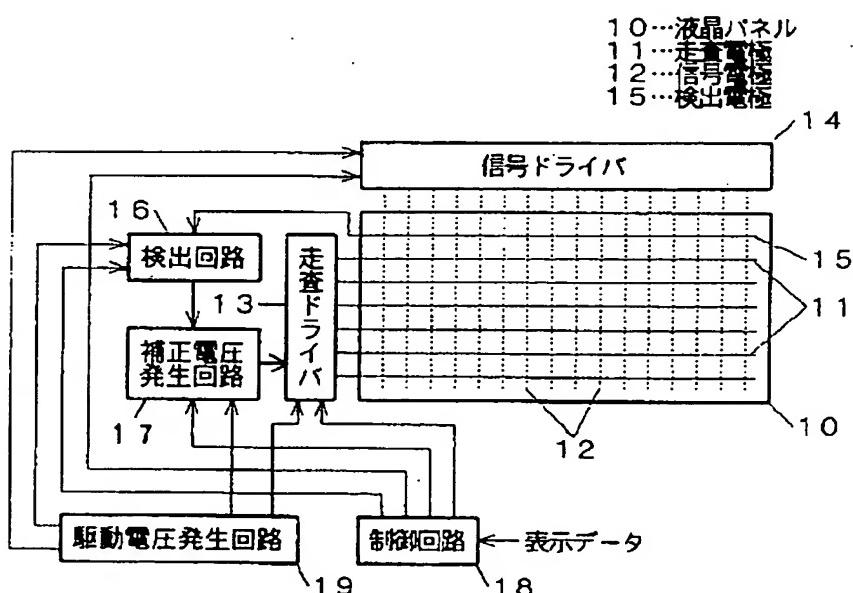
【図20】(a), (b), (c)は従来の液晶表示装置のパルス幅変調駆動方法における走査電極印加電圧波形図、(d), (e), (f)は同駆動方法における信号電極印加電圧波形図。

【図21】(a)は従来の液晶表示装置のパルス幅変調駆動方法における画素の走査電極側の電圧波形の概略図、(b)、(c)、(d)は同駆動方法における画素の信号電極側の電圧波形の概略図、(e)、(f)、(g)は同駆動方法における画素に印加される電圧波形の概略図

【簽署の説明】

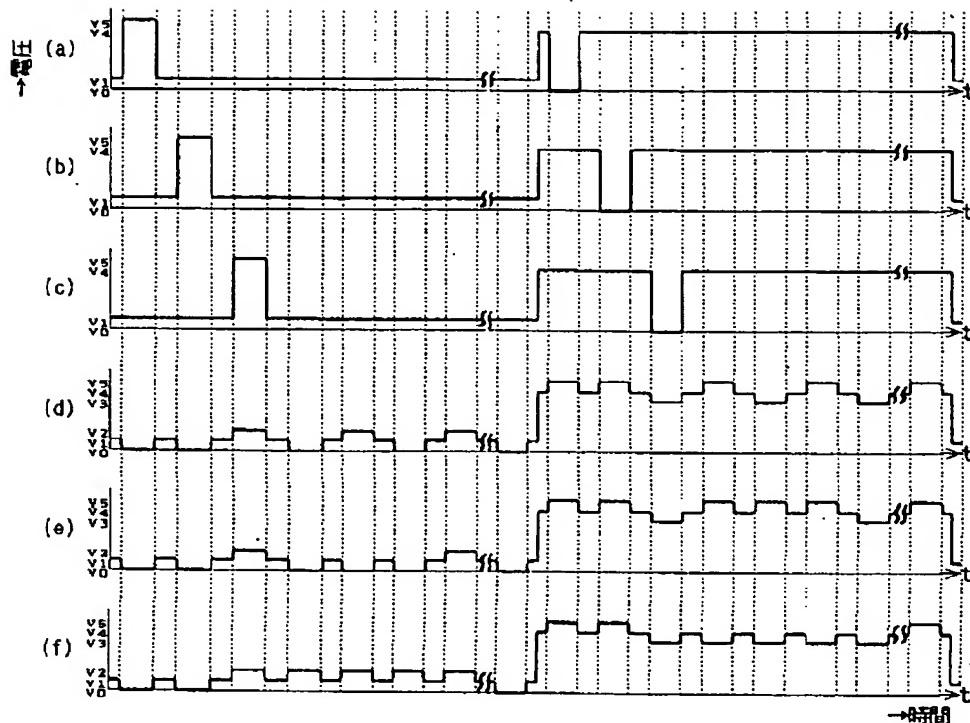
- 1, 2, 3 画素
 10 液晶パネル
 11 走査電極
 12 信号電極
 13 走査ドライバ
 14 信号ドライバ
 15 検出電極
 16 検出回路
 17 補正電圧発生回路
 18 制御回路
 19 駆動電圧発生回路
 100, 110, 130, 140, 150, 160 走査電極
 200, 210, 220 信号電極
 99, 101, 102, 103, 201, 211, 221 ノード

[图 3-1]

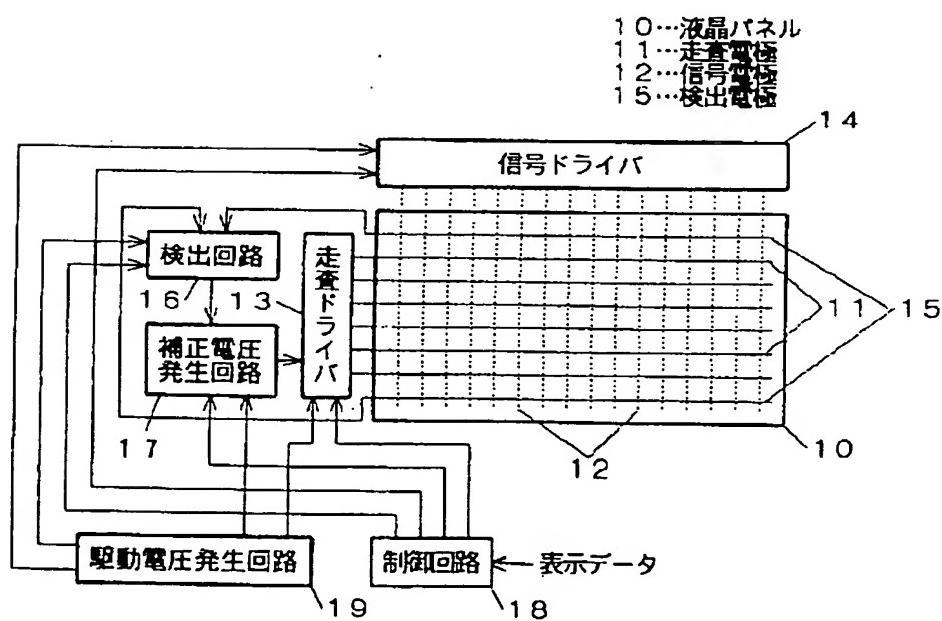


(10)

【図1】

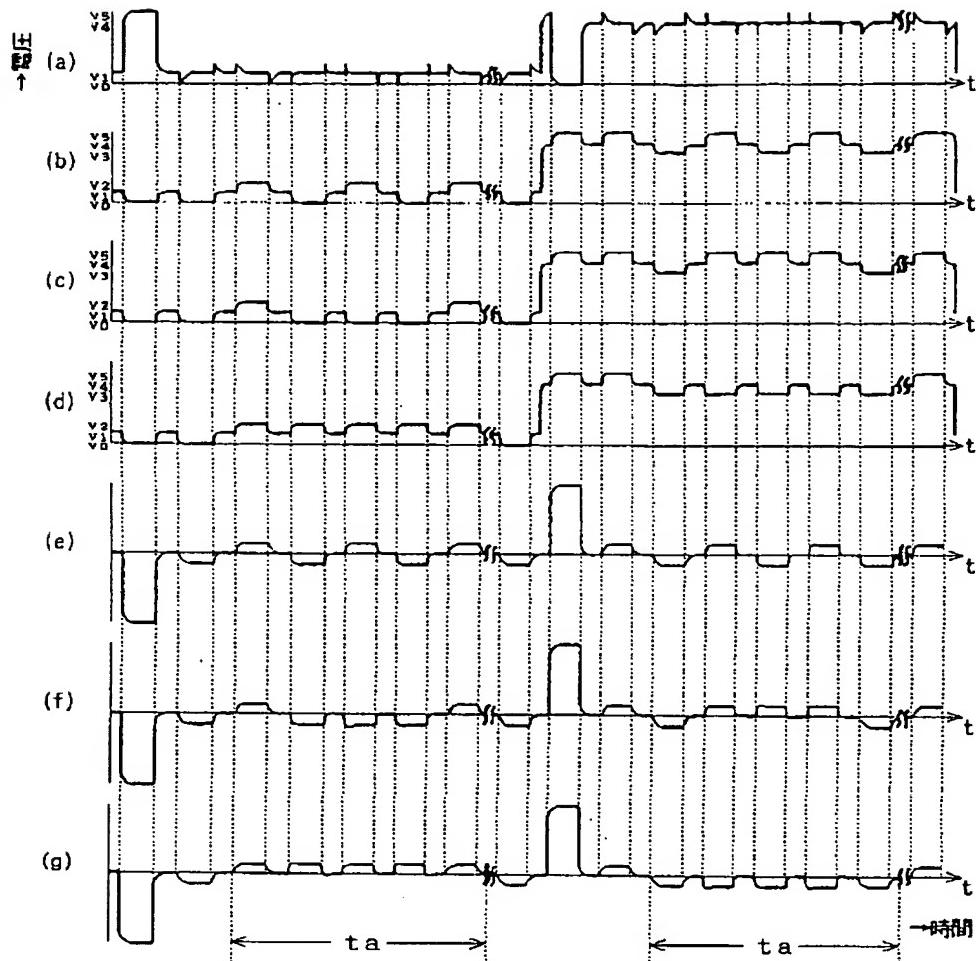


【図4】

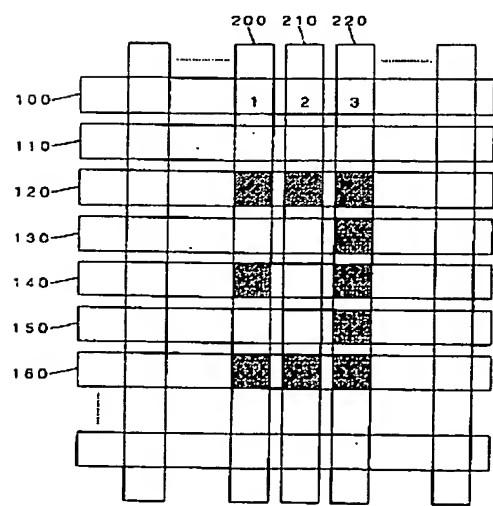


(11)

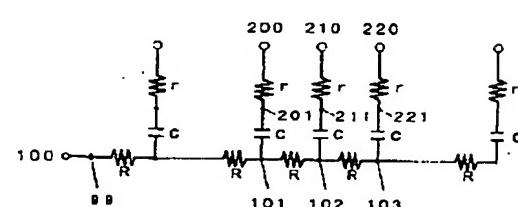
【図2】



【図15】

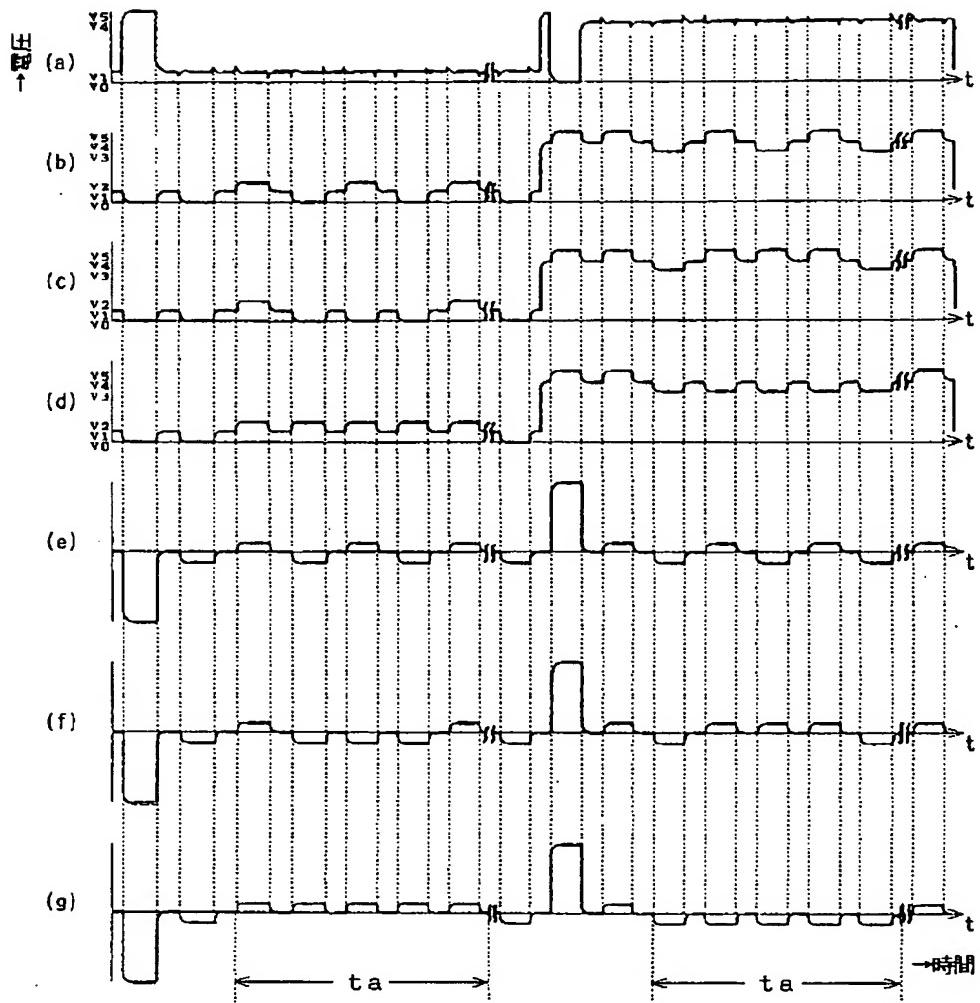


【図16】



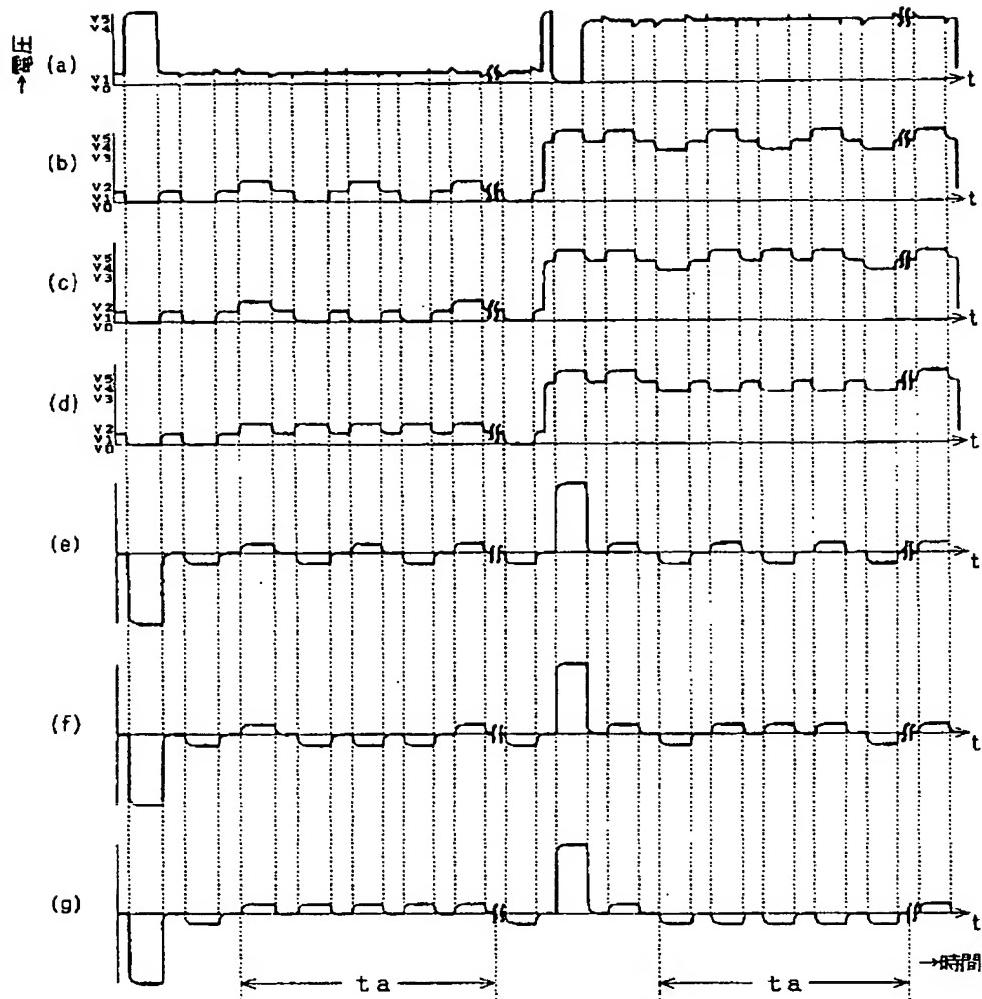
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【図5】



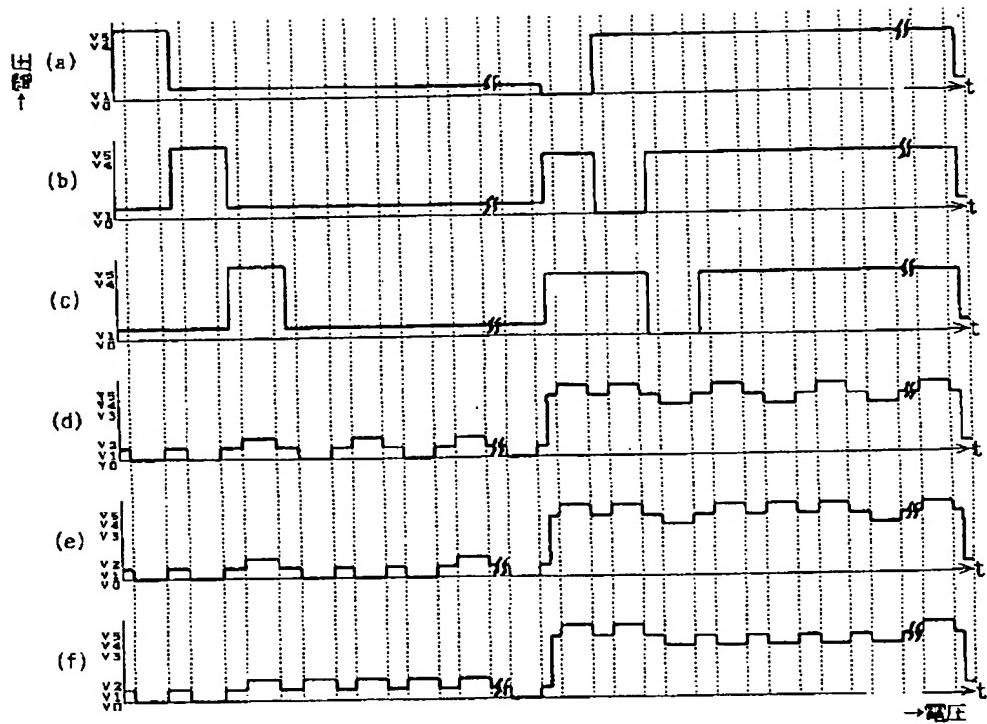
(13)

【図6】

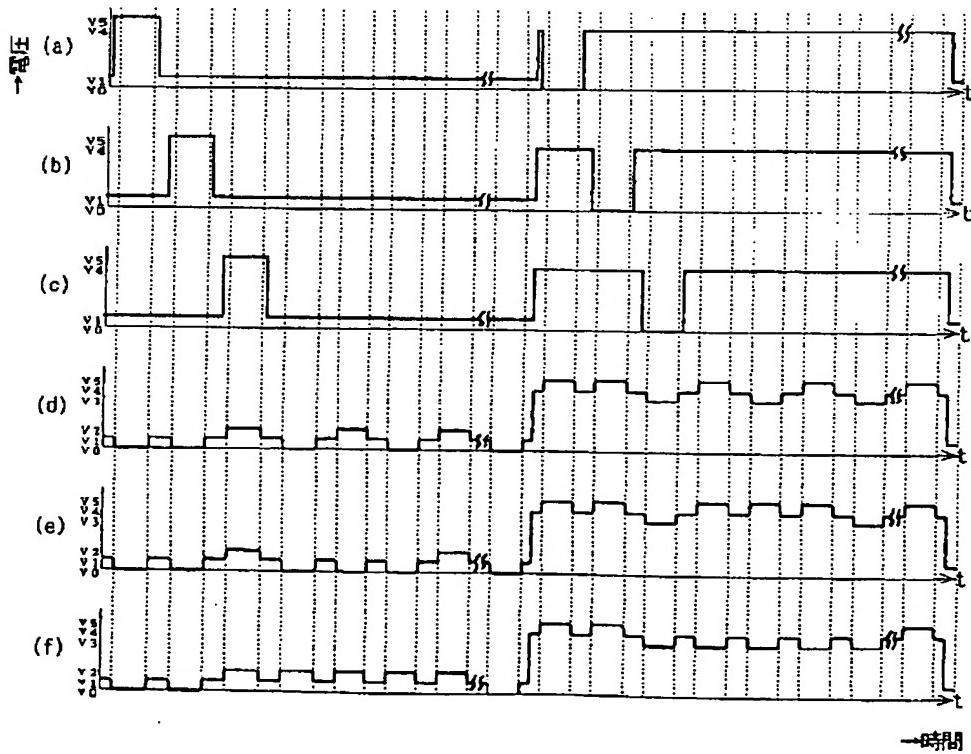


(14)

【図7】

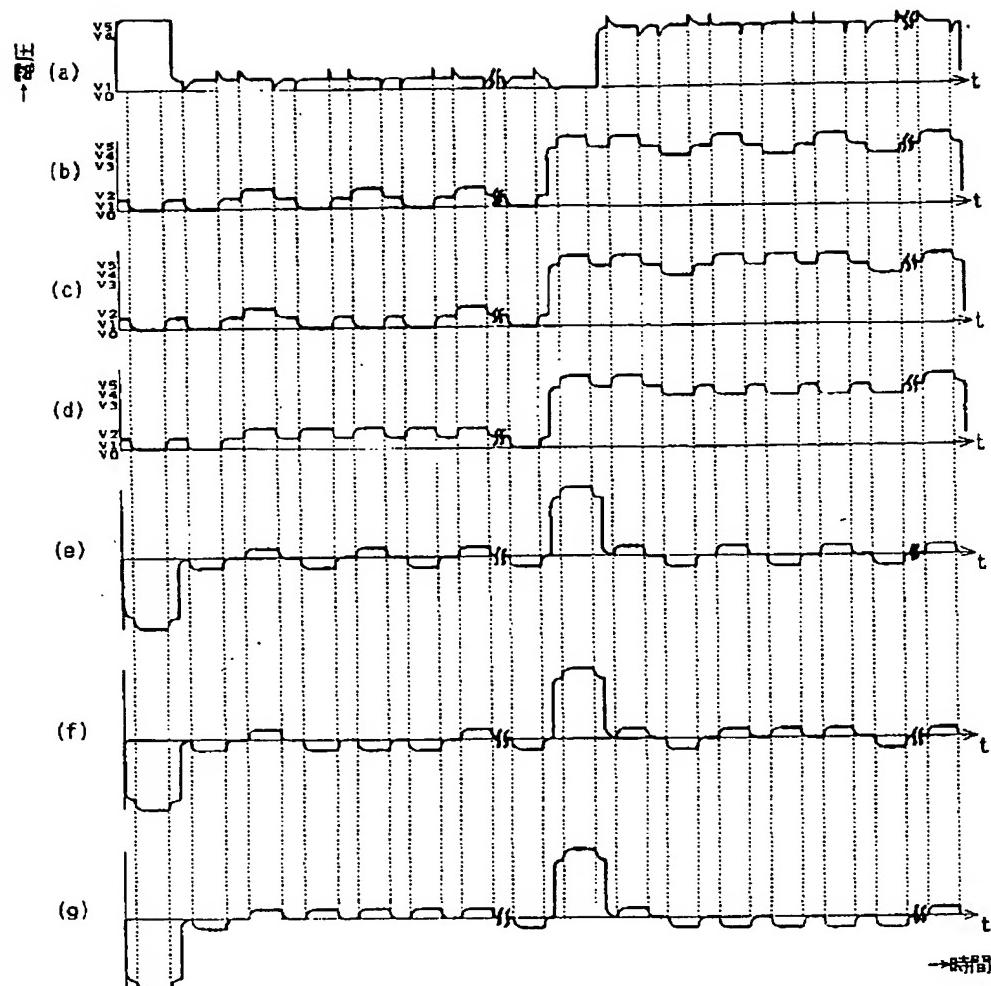


【図9】

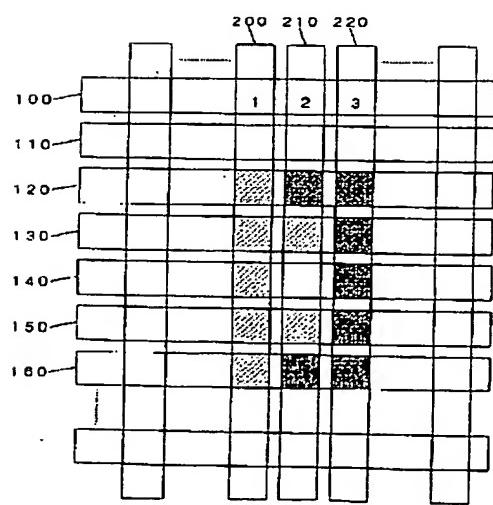


(15)

【図8】

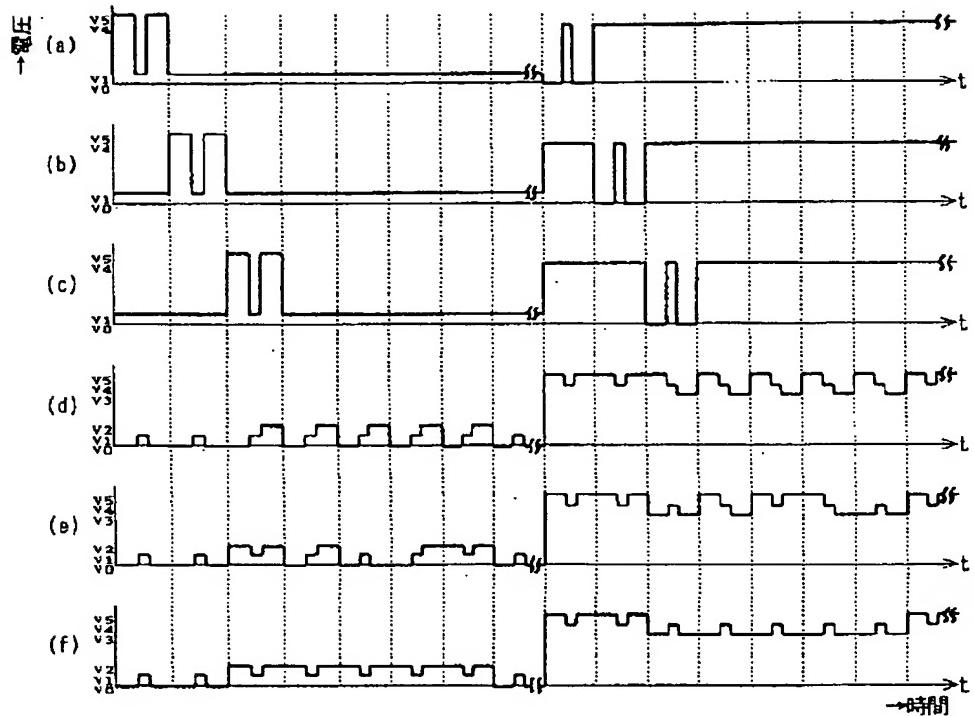


【図19】

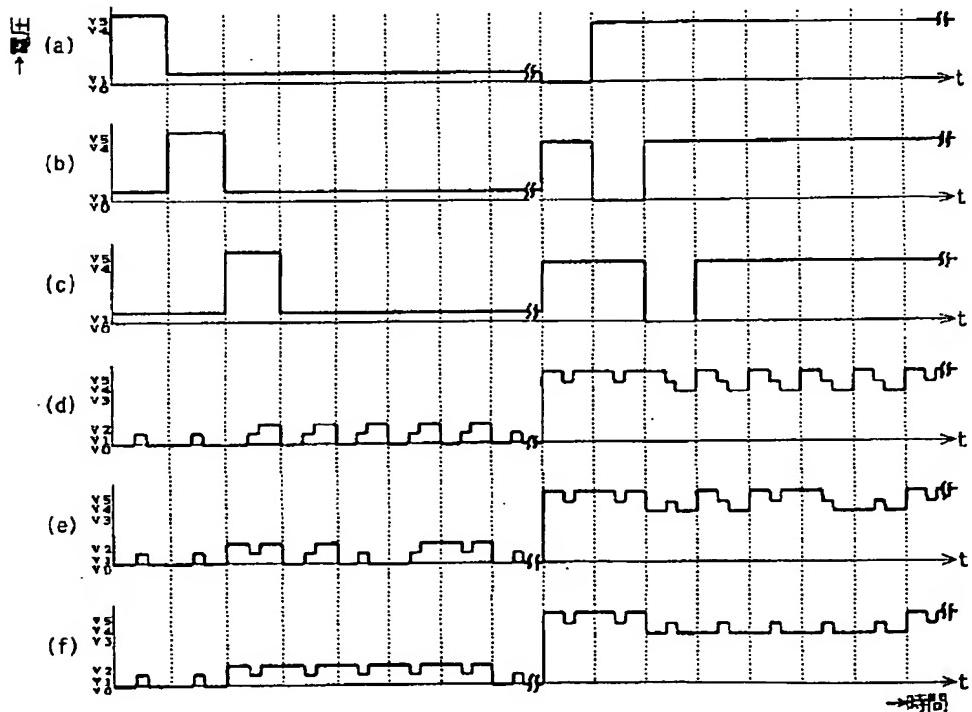


(16)

【図10】

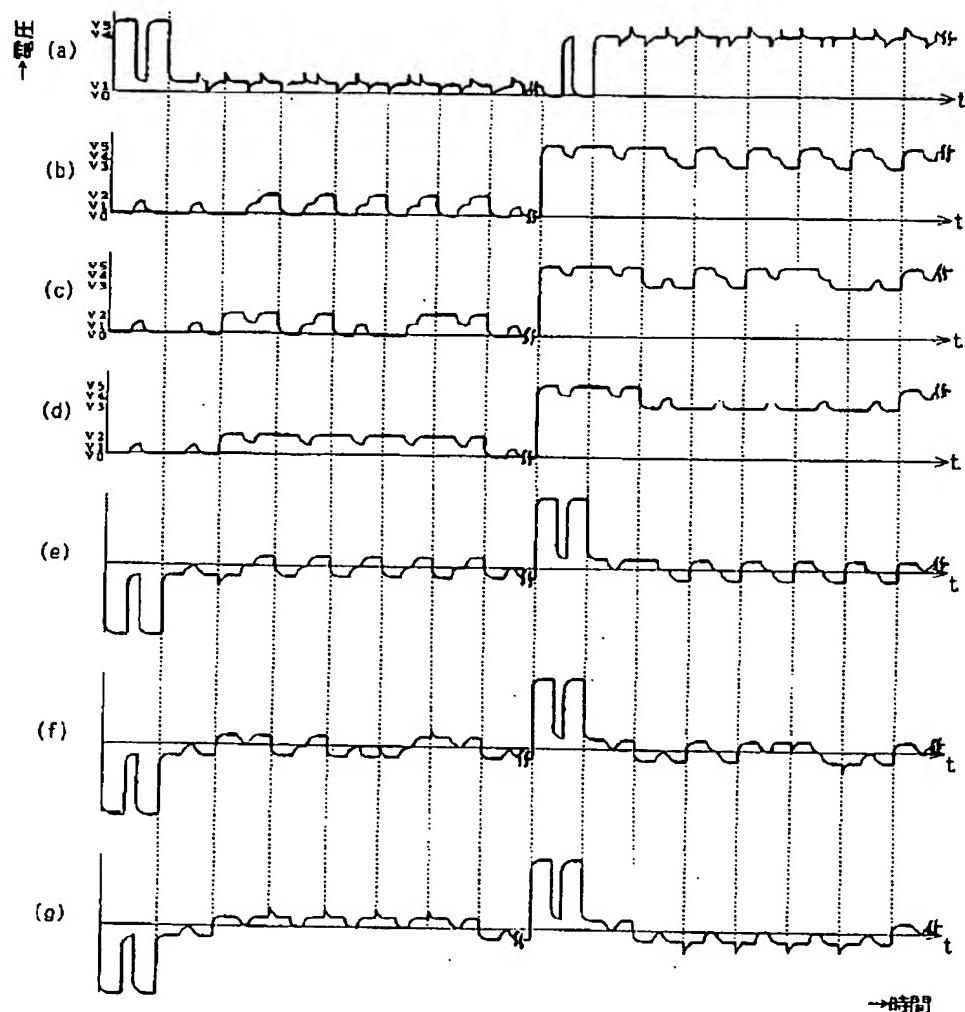


【図12】



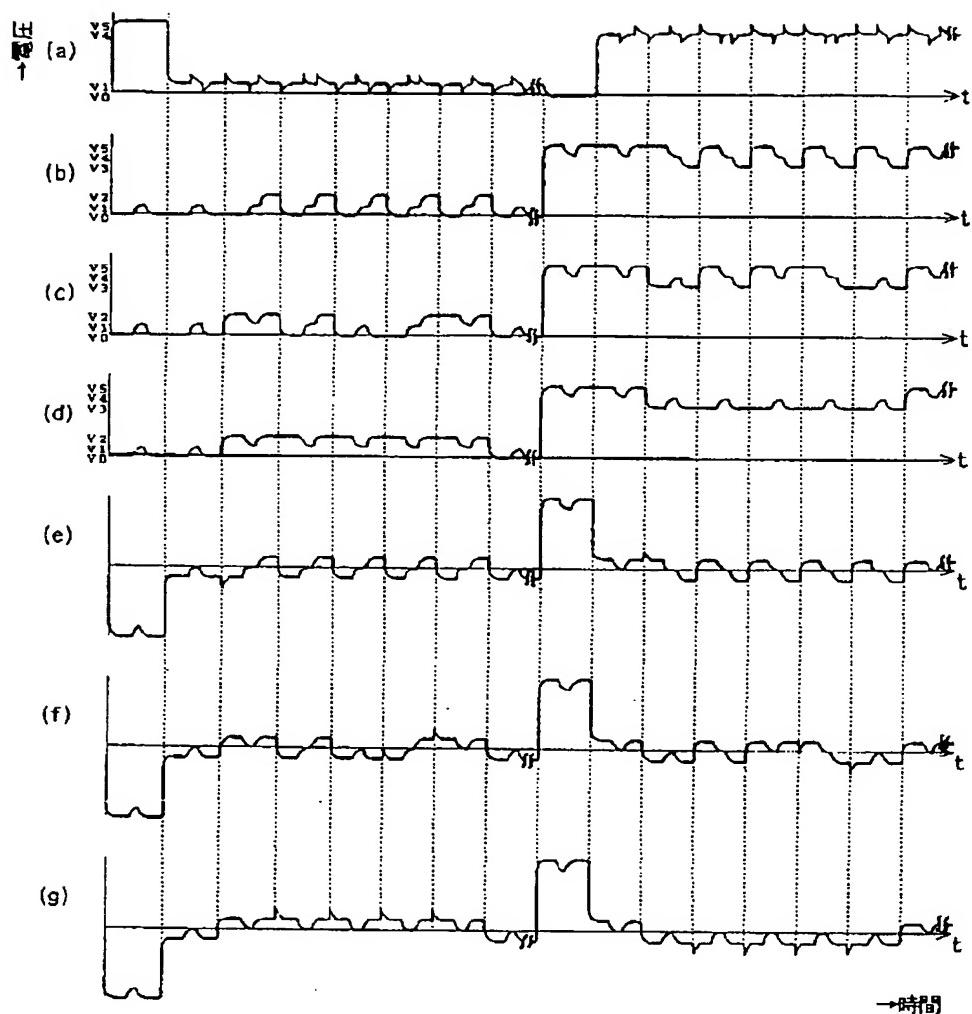
(17)

【図11】



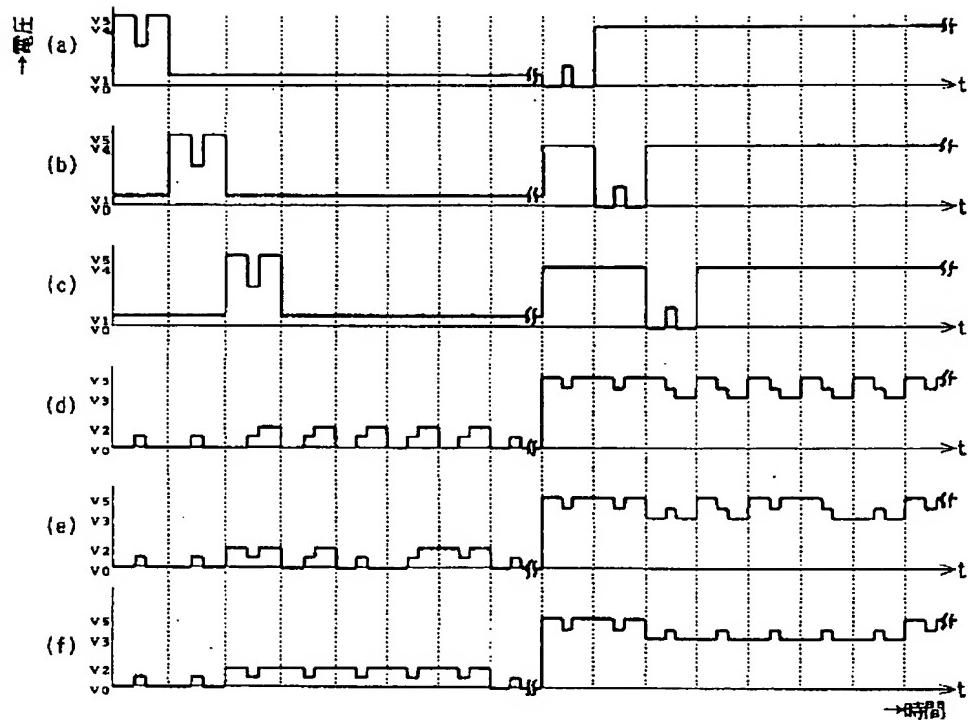
(18)

【図13】

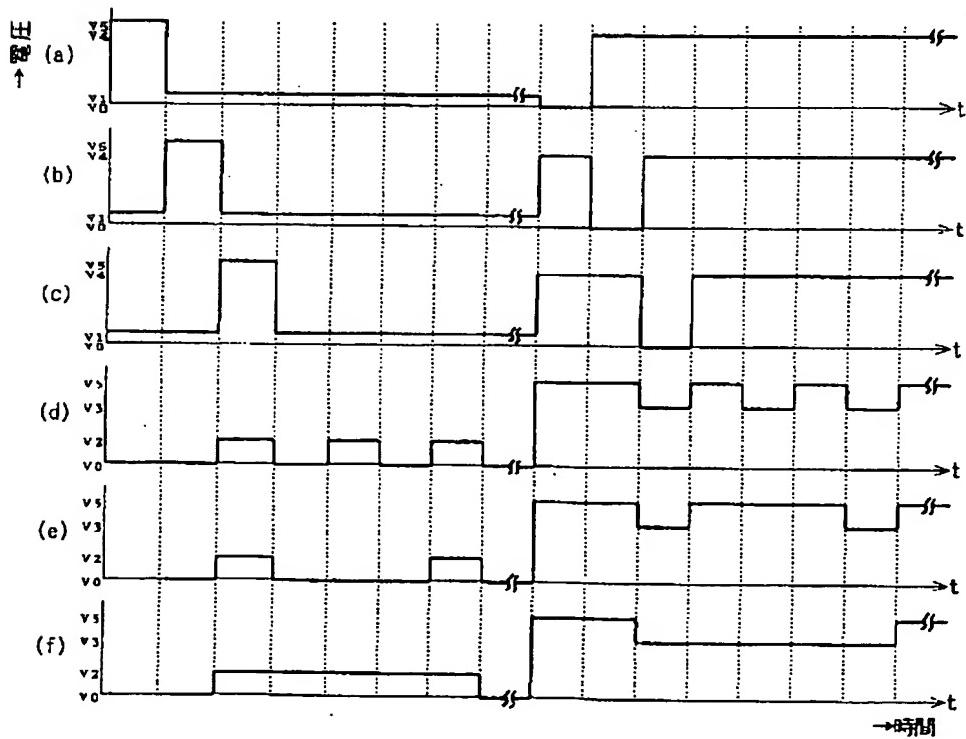


(19)

【図14】

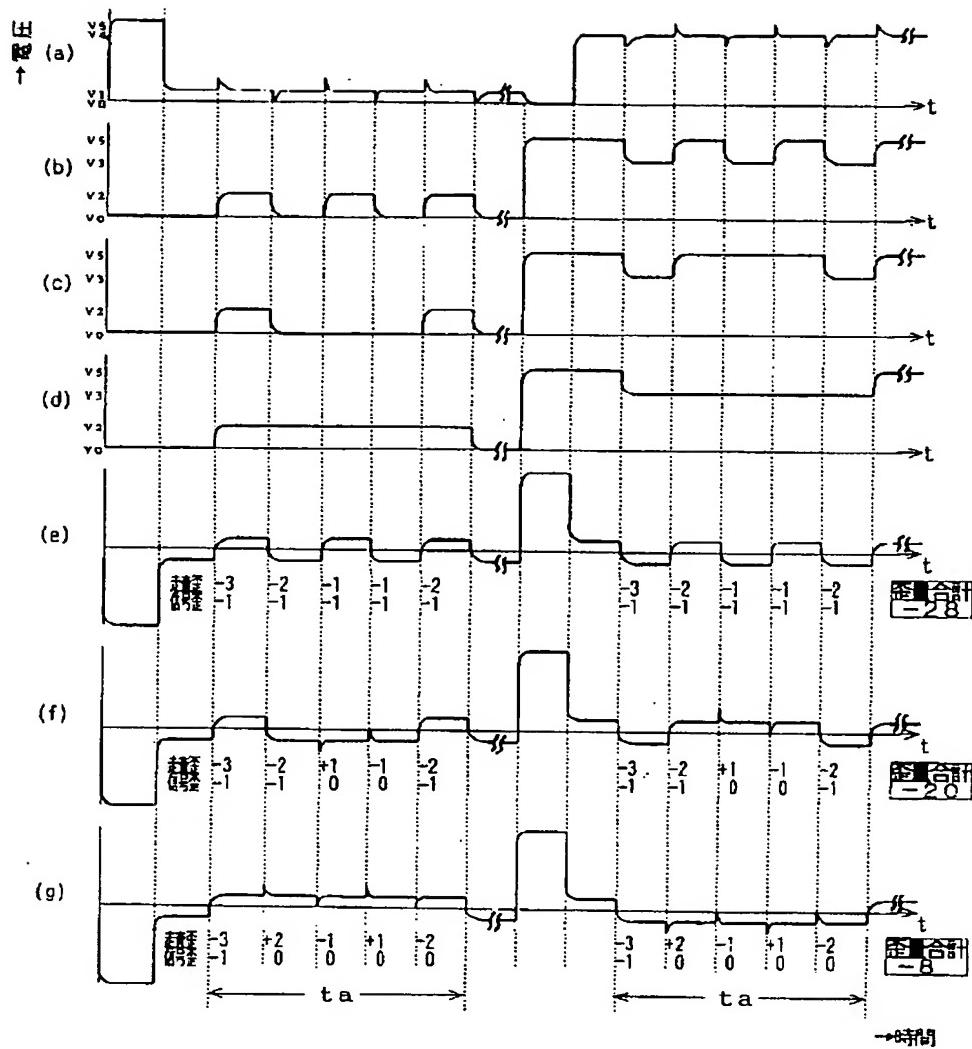


【図17】



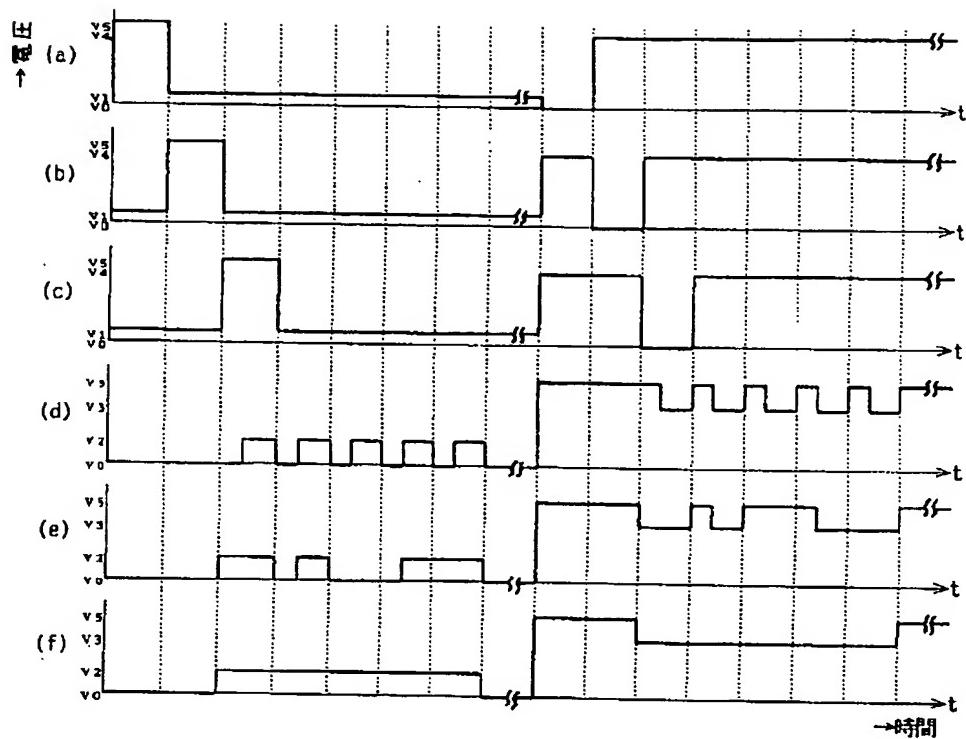
(20)

【図18】



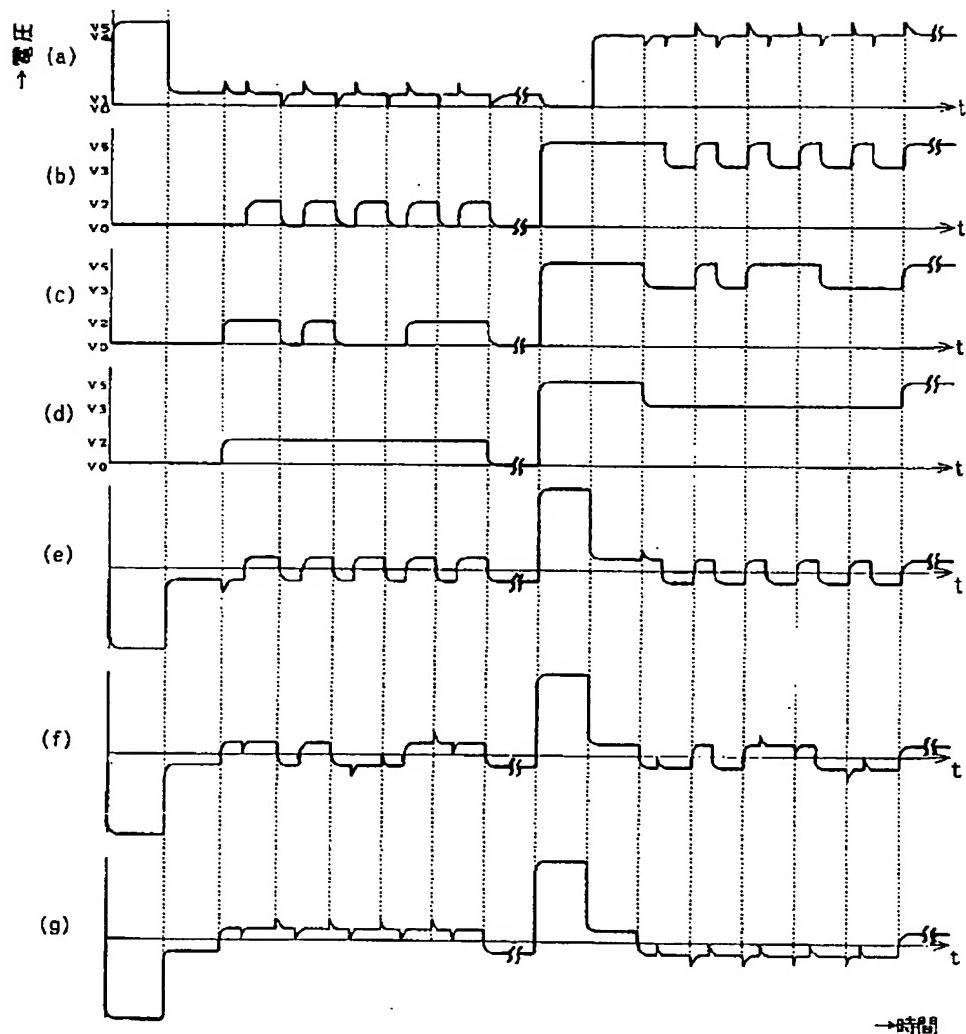
(21)

【図20】



(22)

【図21】



フロントページの続き

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